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THE MAJORITY CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The twenty-first convention of the National Electric Light Association was held in Chicago June 7, 8 and 9. The most noticeable feature distinguishing this convention from those of previous years was the entire absence of exhibits on the part of manufacturing and supply houses. It was considered that the electrical features of Chicago would in themselves give the delegates plenty to see and the representatives of the houses supplying them plenty to talk about.

These conventions, year after year, are becoming more dignified, and more gray-haired men and men of larger business interests and greater responsibilities are to be seen. This was quite noticeable at the last convention. While some regret the absence of the more hilarious features of the early days, this is a change which is sure to come with age, and is undoubtedly a change for the better. The pioneer days in electric lighting are over. There was a time when investments in that field were taken at great risks. Many of these involved heavy losses and everyone felt justified in seeking, where it was possible, large profits. The industry is now an established one. With proper management definite returns may be infallibly foreseen. The resulting change in the attitude of the central station men toward the public is to be seen in the widely prevalent feeling so well expressed in President Insull's paper, as follows: "It is of prime importance to central station managers that they should sell the product they manufacture, namely, electric current, to the greatest number of consumers at the lowest possible price and yet obtain a reasonable profit." This altruistic view of the situation may be in part due to the continued competition of other methods of illumination which have kept pace with the improvements in electric lighting, but it is, nevertheless, a sign of intellectual broadness and of the suppression of the characteristics of Shylock in the industry.

WHAT THE TRAFFIC WILL BEAR.

The opening address of President Samuel Insull before the convention discussed most ably three of the most important problems now before the electric light men, namely: the standardization of machinery, the basis of rates, and municipal ownership. In his remarks on selling price Mr. Insull brought out the influence of the load factor, but neglected one feature that has not been generally recognized in electric lighting hitherto, and that is the equivalent of what railroad financiers term "What the traffic will bear."

This feature is best illustrated by an example from steam railroad practice. Such a road can carry freight of high intrinsic value, such, for example, as market products, textile goods, furnishings, etc., at a rate which will not materially affect their selling price, but if the same rate per ton should be charged against coal, granite and other bulky commodities, it would be prohibitive. If, however, a lower rate is given on the latter, the income derived will still more than pay the added expense due to their transportation. If, in answer to the demands of the shippers of the finer goods, the rates are equalized, coal will not be carried at all and the reduced rates on the other goods will not pay expenses. In other words, by making the finer goods stand the fixed charges on the cost of the roadbed, etc., and taking cheap freight at a rate just sufficient to

give a margin over the increased cost of operation, a greater profit is obtained. This is recognized as a just principle in railroad economics.

The same law applies in the supply of electricity. If the central station can get an added load from business buildings (which have the alternative of the isolated plant) only by offering a rate much lower than that which would pay if given to all consumers, it may be justified in so doing, by the fact that the added income would more than cover the added cost. This is true even if a lower rate is given on a load with no greater size or better load factor than many other loads charged higher rates. It is due to the fact that, for example, a 10 per cent. increase of the load increases the total costs perhaps only 5 per cent., as the cost does not increase proportionately with the load, and a 6 per cent. increase of the income will improve the dividend. For this reason the principle of "one price to all" is not properly applicable to electric lighting. This is obviously the justification for low rates on motor service.

DIRECT VERSUS ALTERNATING CURRENTS.

A merry battle in this forty years' war was precipitated at the convention by the papers read by Mr. H. A. Wagner and Mr. L. A. Ferguson, an abstract of the former of which and of the discussion may be found in other pages of this issue. Mr. Wagner described in detail the advantages of a system in alternating-current working, which, while not entirely new, possesses many advantageous points. Briefly, the plan comprises a system of low tension interconnected mains and services with no high-tension mains, but transformers inserted, so to speak, in the feeders. By this plan the drop of the transformers could be compensated for with the drop of the feeders, by manually operated feeder regulators at the centre of generation. The transformer regulation could, therefore, be sacrificed for low iron loss, and the enormous copper investment of low-tension feeders could be saved.

It is difficult to compare such a system with standard low-tension service, but the low-tension people have practically admitted that, for the supply of electricity in large cities, it is advisable to generate high-tension alternating current at some outside point where condensing water and cheap fuel and more moderate land values can be obtained, these currents being transformed in rotary sub-stations to low-tension direct currents. Let us compare this with Mr. Wagner's proposed system. The generating station, transmission lines and step-down transformers of the two would be identical. The direct-current plan would require, in addition, rotary transformers with attendance in sub-stations connected by low-tension feeders to the mains. With the alternating system, the transformers, being far simpler and capable of further sub-division, could be placed immediately at the feeder junction boxes; thus doing away entirely with all rotaries and low-tension feeders. Closer regulation could be obtained than by the direct-current system unless the latter were equipped with a large number of auxiliary buses for properly boosting the low-tension feeders. The advantages of the alternating system are obvious.

Direct-current advocates admit the necessity of alternating current for the supply of scattered lighting. Their complete system, therefore, requires direct current in the congested district and alternating current outside of it. The disadvantages of this lack of homogeneity, such, for example, as the different types of motors and arc lamps required for the two districts, are too well known to require elaboration.

Mr. Wagner states that the three-phase system cannot be used successfully for lighting services, and explains that this is due to the mutual interference of the several phases in machine reaction and feeder drop. No intelligent engineer would dream of using a three-phase three-wire star system for such service, and the voltage of any one side of a three-phase mesh system can be changed without disturbing the other sides by properly manipulating the three feeders. The interference, internally in the generator, is no worse in a three-phase than in a two-phase or a monocyclic machine. It is worthy of note in this connection that every motor, induction or synchronous, on a multiphase circuit is itself an equalizer.

President Insull, of the Chicago Edison Company, advocates direct current on the score that it has been used about as at present for fifteen years and that the alternating-current plan proposed is comparatively untried. If it had not been for the continued and repeated violation of this principle we would still be illuminating by pine knots. This argument is the strongest one presented for alternating currents. If the present outlook appears favorable the future development, which will undoubtedly be more rapid than that of the more finished direct-current system, will still further increase the advantages of the alternating.

MUNICIPAL OWNERSHIP.

The paper on this subject read by Mr. Alexander Dow at the recent convention will undoubtedly take the place of a classic on the subject. Mr. Dow makes the eminently sensible argument that, first, municipalities have a perfect right to generate the current for their own lighting. Second, they are not entirely justified by American principle of government in the generation of current for private lighting, which is a service to the minority of individuals. Third, the private lighting being supplied by a corporation, the current for municipal lighting can be supplied by the same corporation with a reasonable profit for less than the city can operate its own plant, owing to the advantages of combined generation, improved power factor, etc. Therefore, cities should light by contract.

The change in the attitude of central station men on this subject is most gratifying. Some still cling to the mediæval idea that municipal ownership is all wrong in principle. Others, like the speaker following Mr. Dow, cling to the peculiar financial doctrine that depreciation should be charged up against the capital account instead of the operating expenses. It is hardly necessary to state what the owner of a manufacturing establishment in any other line would say if such a course were proposed to him. But the great majority believe that privately owned plants can supply public lighting more cheaply than municipally owned plants, if given proper security against confiscation and competition, which security is properly obtainable in exchange for reasonable public control of the price to private consumers.

To Celebrate the Discovery of the Voltaic Pile.

An exposition will be held in Como, Italy, next year to commemorate the centenary of the discovery of the voltaic pile, which is so named after its discoverer, Alessandro Volta. The exposition will be divided into two sections, an international electrical exposition and a national exposition of the silk industry. It will be opened in May and will close in October, 1899. A congress of electricians will also meet during the exposition. The exposition will be an historical one, representing the development of electricity during the present century, and the congress of electricians will discuss the scientific progress during the century and the new and numerous applications of electricity. The electrical exposition will be divided into thirteen classes; the first being the class of honor, and will illustrate, with apparatus, the discovery of Volta, and include bibliography, autographs, portraits, medals, etc.

The Reliability of Magnetic Tests Made with a d'Arsonval Ballistic Galvanometer.

BY SAMUEL SHELDON AND TOWNSEND COCKS.

It has frequently been urged that magnetic tests made by means of a d'Arsonval ballistic galvanometer are not to be relied upon.

The great strength of the d'Arsonval galvanometer field, as compared with the field of the suspended magnet in a galvanometer of the Thomson type, is responsible for the difference in action between the two styles of instruments. The suspended coil in the former by its swinging induces E. M. Fs. which will cause currents of varying magnitudes depending upon the resistance in series with the galvanometer, but external to it. These currents damp the oscillations of the needle and influence the magnitude of throw corresponding to the passage of a given quantity of electricity. The smaller the resistance in the external portion of the circuit the greater will be the current induced by the vibration and the smaller will be the galvanometer constant. In a galvanometer of the Thomson type the oscillating needle does not induce currents in the coils sufficient to affect the galvanometer constant to as great an extent. The curve in Fig. 1 shows the relation between the resistance of the galvanometer circuit and the throw per microcoulomb with a d'Arsonval galvanometer of 1030 ohms resistance and eleven seconds' time of oscillation. When the resistance external to the galvanometer is small the constant is quite sensitive to small changes in this resistance. Evidently if the galvanometer is to be used with a test coil of small resistance it should be calibrated with an equal resistance in circuit. If the calibration be made according to the earth inductor method the standard solenoid method, or the time of oscillation and logarithmic decrement method, the resistance external to the galvanometer can be easily made of any magnitude. If the calibration be made according to the much more convenient standard condenser method, it is necessary to make use of a double-tongued key or an equivalent device. Such a key has an upper and a lower contact. In operation it charges a condenser from a standard cell, discharges it through the galvanometer, and then immediately closes the galvanometer through a resistance which can be adjusted at pleasure. The method of connection is shown in Fig. 2. It is interesting to note from Fig. 1 that, if the coil of the galvanometer could be constructed of wire having zero resistivity, the damping would be infinitely great. A slight movement of the coil would induce a very small E. M. F., which would produce an infinite current, thus preventing a throw of appreciable magnitude.

To prove experimentally that concordant results would be obtained, irrespective of the resistances of the galvanometer circuit, so long as the corresponding constants were employed, a test ring was subjected to a constant magnetizing force of such a magnitude as to bring the induction up to the knee. The magnetizing current was reversed and the induction calculated from the throw in the galvanometer. This was repeated with various resistances in the galvanometer circuit. The results were as follows

Ohms in series with galv.	Induction B.
0	10250
100	10380
500	10280
1000	10210
2000	10220
4000	10120
10000	10250

The values of B are as alike as could be expected to result from a deflection method.

A further test was made to determine whether the value of the hysteretic constant, as determined by the step-by-step method, using a d'Arsonval ballistic galvanometer, was the same as that yielded by the wattmeter and alternating current method. The test sample was made up of stampings from an iron which was known to have a large hysteretic constant. The test by the first method was made in the usual manner except that the observations were started from a condition of maximum magnetization. Under such circumstances the ends of the ascending and descending curves meet, and the fact that they do meet is a check on the accuracy of all the observations. This method of procedure does not require a demagnetized condition of the sample at the start. Furthermore, the lower ascending curve coincides with the curve obtained by the method of reversals on the same sample. The value of the hysteretic constant as obtained by this method was

$$\eta = 0.0039$$

The wattmeter test was made with an arrangement of apparatus, as shown in Fig. 3, where V represents a Cardew voltmeter and A a Hartmann & Braun hot-wire ammeter. The wattmeter readings give the total loss in the test sample when carrying alternating currents. The reading of the ammeter and a knowledge of the resistance of the coil on the sample gives the $C^2 R$ loss, which in these observations was very small. To eliminate the Foucault current losses observations were taken at two different frequencies, the sample being subjected to the same flux density.

The constant was then calculated from the following formula derived from the formula given by Steinmetz (Proc. A. I. E. E., ix. p. 22)

$$10^7 W = \eta B^{1.6} + \varepsilon f B^2$$

Where

W = Watts lost per cm³ per cycle.
f = Frequency of alternations.
η = Hysteretic constant.
ε = Foucault loss constant.
B = Maximum flux density.

The value of B is calculated from the voltmeter reading E, the

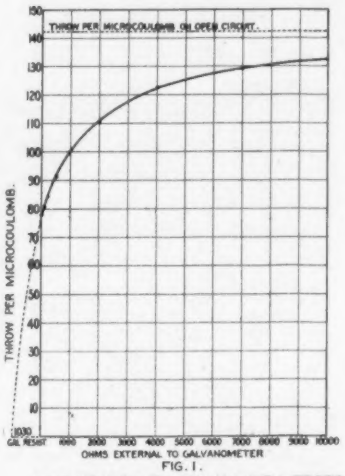


FIG. 1.

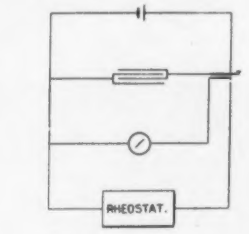


FIG. 2.

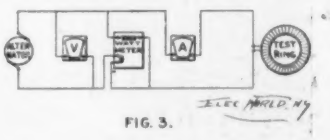


FIG. 3.

THE RELIABILITY OF MAGNETIC TESTS MADE WITH A D'ARSONVAL BALLISTIC GALVANOMETER.

number of turns on the test sample n, and the cross section S, by the formula,

$$B = \frac{E\, 10^8}{\sqrt{2}\, \pi\, n f\, S}.$$

The results obtained with frequencies of 172 and 116 were

$$\eta = 0.0043$$
$$\varepsilon = 0.00000013$$

It will be seen that the value of the hysteretic constant, as determined by the step-by-step method, is smaller than that obtained by the wattmeter method, but either value is sufficiently near to that which is probably the true value to serve satisfactorily in all loss calculations. The difference is not to be attributed to the form factor of the alternating-current wave employed, nor to the effect of the radial thickness of the test sample, for the effect of both these influencing causes was considered. It is probably due to a viscous hysteresis or the magnetic creeping which goes on during the interval between the successive observations of the step-by-step process. This would make the area of the hysteresis loop smaller than if the cycle were accomplished in the fractional part of a second. An endeavor was made to discover an evidence of this creeping by obtaining different hysteresis curves, the interval between the steps being varied from thirty seconds to three minutes. All of these curves were coincident.

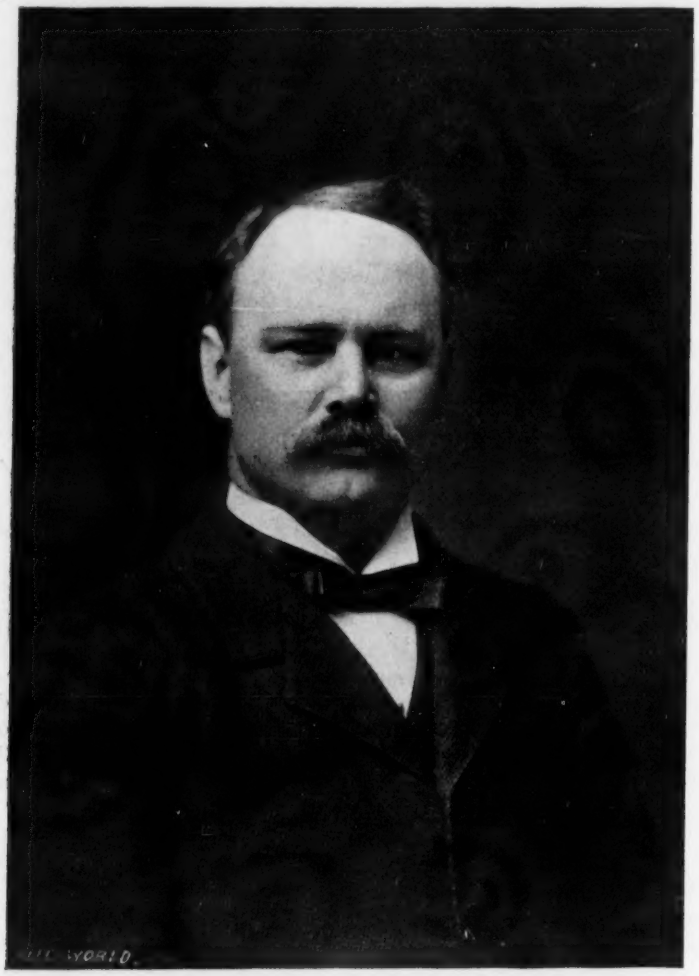
It must, therefore, be concluded that the results obtained from a d'Arsonval ballistic galvanometer, when properly manipulated, are to be relied upon. Furthermore, a d'Arsonval galvanometer, which is quite heavily dampened, which is of low resistance, and which has a time of oscillation as small as one second, can be made to yield accurate results. This small period, combined with the heavy damping, gives quick results and obviates the many annoyances which are assocated with very sensitive long swing ballistics.

On the other hand tests for hysteretic constants can be more conveniently carried out with the wattmeter, and this latter method has the advantage that the tests are made under the same conditions, as will subsequently exist when the iron is performing its commercial functions.

The New Officers of the National Electric Light Association.

A. M. Young.

Mr. Alden M. Young, the newly elected president of the National Electric Light Association, was born at Hadley, N. Y., Sept. 6, 1853. After leaving school he entered the telegraph business, filling positions with the old Atlantic & Pacific Telegraph Company successively at Saratoga, Albany, Syracuse, Buffalo, and finally at New York. In 1878 he organized the telephone exchange at Waterbury, Conn., and afterward became interested in the electric light and street-railway business, organizing several companies and contributing largely to the successful introduction of similar enterprises in several New England towns. Mr. Young has for many years been closely identified with central station work throughout New England. He is particularly interested in commercial lighting, and is establishing the large central station of the Kings County Electric Light & Power Company in the Borough of Brooklyn, New York City, of which company he is general manager, although he still retains his interests in the New England enterprises. He formed the New England Engineering Company, of Waterbury, and is now president of that concern. He is, besides, actively engaged in the management of several companies in Connecticut, Massachusetts and in New York, among them being the Central



A. M. Young.

Railway & Electric Company, of New Britain, Conn., of which he is president; the Waterbury Traction Company and the Norwich Gas & Electric Company, occupying the position of secretary of both the latter concerns.

E. W. Rollins.

Mr. Edward W. Rollins, first vice-president of the National Electric Light Association, is a son of the late Edward H. Rollins, United States Senator from New Hampshire. He was born in Concord, N. H., November 25, 1850; graduated from the Institute of Technology as a mining engineer in 1871; went to Colorado in 1872, and was resident engineer of the Colorado Central Railroad until 1876, when he left the railroad and went into the banking business in Denver, Col., making a specialty of handling municipal securities. This business he has followed ever since, and he is now the president of E. W. Rollins & Sons, bankers, 19 Milk Street, Boston, and Denver, dividing his time between Denver and Boston. In 1880 he became interested with other gentlemen in the organization of the Colorado Electric Company, of Denver, Colo., and in 1887 he was one of the organizers of the Denver Light, Heat & Power Company, which two corporations were afterward merged into the Denver Consolidated Electric Company. Mr. Rollins has practically managed the electric lighting interests of the Denver Consolidated Electric Company, and its predecessors since 1880, and is, and has been for many years, the president of the company.

F. A. Gilbert.

Mr. F. A. Gilbert, who was elected second vice-president of the National Electric Light Association, is one of the most active and progressive officials in the electric lighting business, and one of the most widely known because of his responsible position as president and general manager of the Boston Electric Light Company, which

E. W. Rollins.

F. A Gilbert.

he has held continuously since 1886. Prior to this time he was interested in the New Haven (Conn.) Electric Light Company and Bridgeport (Conn.) Electric Light Company, disposing of his interest, however, in these two latter companies a few years ago. Aside from the Boston Electric Light Company Mr. Gilbert is at present interested in the Consolidated Electric Light Company, of Portland, Me., of which he is vice-president, and the Newport (R. I.) Electric Light Company. Under Mr. Gilbert's able direction the Boston Electric Light Company has grown to enormous proportions and is at present constructing one of the largest and most complete electric lighting stations, embodying the latest and most efficient improvements. Mr. Gilbert is also president of the Massachusetts Electric Lighting Association, and is mainly responsible for its organization in 1889, since which time he has continuously served as its president. The principal object of this association is to protect electric lighting and gas companies from adverse legislation, in which effort it has been especially successful, owing to the untiring efforts of Mr. Gilbert. Mr. Gilbert served as chairman of the executive committee of the National Electric Light Association in 1887, when the convention was held in Boston, and has since at various times been conspicuous in its affairs. Mr. Gilbert was born in Connecticut April 29, 1847.

President Insull's Address.*

Ladies and Gentlemen:—In calling to order the annual convention of this association my dual capacity presents somewhat of an embarrassment to me. I am in doubt whether as president to enlarge upon the great growth of this association since its formation in this city on February 25, 1885, or whether as a resident here to dwell at length upon the marvelous growth of the city in which we meet. Chicago and the industry with which we are identified have a somewhat close connection. The growth of the former, if measured from the point of view of the rapidity with which history is made, is, so to speak, the product of yesterday. The electrical industry, or rather that portion of it with which we are associated, is but little more than the product of to-day. If the growth of this city and that of our own industry is as great during the next thirteen years as the progress that they have achieved since the date of your first meeting here, I am sure that both the citizens of Chicago and the members of your association will have every reason

*Abstract of presidential address delivered before the National Electric Light Association, twenty-first convention, Chicago, June, 1898.

to congratulate themselves. Speaking for those of my friends connected with the electrical industry in Chicago, and also for myself, I can assure you that it affords us very great pleasure to welcome you at this convention, and the fact of your meeting in this my home city enhances not a little my high appreciation of the privilege of presiding on this occasion.

STANDARD VERSUS SPECIAL MACHINERY.

A matter which has called forth during the last year considerable discussion is the question of the use of standard apparatus and the tendency toward the specification of special machinery on the part of electrical engineers. This course is not by any means confined to large work, but is followed by some engineers whether they are designing a small isolated plant or are projecting a large modern central station. It would seem to me to be of paramount importance to the manufacturer and user that both should co-operate in eliminating as far as possible from the business the necessity of building and using special types of machinery. This can only be done by the adoption of standard specifications for various standard types of apparatus. A committee of the American Institute of Electrical Engineers has already taken this subject under consideration, and I believe that we will be serving alike the interests of the manufacturers and users of electrical apparatus if we will take some action with a view to co-operating with the institute and other bodies in this matter. Constant duplication of parts resulting in constant duplication of a given piece of machinery means, as any manufacturer will tell you, constant reduction in cost. Variation from a given type means increased cost and even the wiping out of an apparent profit. In the last year or so there has been a great deal of discussion in England, prompted by the success of American manufacturers in obtaining large contracts for electric traction work in Great Britain, and the inquiry has often been made, how is it possible for American electrical manufacturers, with high wages against them, to compete with English builders, whose scale of pay to their workmen is on a very much lower basis. If you will examine into the amount of electric traction machinery manufactured in this country under a system of constant duplication and the use of special tools, and then visit the electrical establishments on the other side of the water and note the tendency there toward specializing each particular job, you will soon recognize that the reason for low cost and consequently low selling price on this side of the ocean is brought about by the fact that in America this class of work is largely designed by the manufacturer, and as a natural result is the duplicate of something already produced, while on the other side of the Atlantic the builder of the machinery works from the plans of the electrical engineer, which necessitates his producing something different to fill each different contract. In one case the machinery is really manufactured; in the other case the builder runs a jobbing shop. Unfortunately during the last few years American users of electrical apparatus have somewhat departed from the pursuance of what is really a fundamental principle of American manufacture, namely, the use of existing types which are turned out in large quantities with special tools with a view to the lowest possible cost of production. The electrical engineer for the purchaser has been permitted to draw up specifications which have tended toward the specializing of apparatus, necessarily interfering with rapid manufacture and low cost of the product. Another objection to special apparatus is the expense and delay in obtaining duplicate parts in case of break down.

The consideration of the subject of standard specifications would naturally include the preparation of specifications with relation to the manufacture of incandescent lamps. For several years past a committee of this association has had this subject under consideration. It has been found practicable by a number of large central station companies connected with another association and buying from one manufacturer to purchase their lamps under specifications which provide for the testing of samples of the product of the factory, the payment for lamps supplied being based on the results of the tests. It seems to me that it would be possible to adopt standard specifications under which our members could purchase lamps from any reputable lamp manufacturer.

SELLING PRICE BASED ON COST.

It is of prime importance to central station managers that they should sell the product they manufacture, namely, electric current, to the greatest number of consumers at the lowest possible price, and yet obtain a reasonable profit. If you will make a careful examination of the factors entering into the cost of current you will very quickly come to a realization of the fact that interest is by far the most important single element, and that this item varies very considerably with the different classes of service furnished by a central station company. The interest factor in cost depends upon the yearly average time of consumption of your product by the customer; or, to put it another way, you can figure your interest on the basis of so much per unit of output at maximum load. For instance, take two probable extreme classes of customers to whom the central station company supplies current for lighting purposes. On the one hand, you have an office building whose tenants only use artificial illumination for a very short space of time each day during the winter only. On the other hand, you have a basement customer whose use of your product averages nearly one-half of the day of twenty-four hours during the whole year. Your investment per lamp, to take care of each of these customers, is practically the same; therefore, your total interest cost must be the same in both cases, but if you distribute this interest cost over the actual units or kw-hours consumed you will find that the tenant of the office building costs you for interest per unit of current sold many times more than does the occupant of the basement. Surely, if the cost of production varies according to the different conditions under which your customers use your product, it is but fair that the selling price per unit should vary correspondingly. If it does not, you, of necessity, encourage the use of electricity by customers whose business is unprofitable to you, and discourage the use of your product by customers whose business at a lower price would yield you a fair return.

PUBLIC CONTROL AND PRIVATE OPERATION.

A subject of growing importance to a number of our members is the question of the public ownership and operation of the undertakings now operated by electric lighting companies. The agitation in connection with this subject has called forth a great deal of discussion, partly by those interested in it simply with a view to extending the influence of political parties, and partly by serious disinterested thinkers who believe that the best interests of the greatest number are to be obtained by the creation of a municipal socialism, which, if carried to its logical conclusion, must ultimately result in municipalities performing, with others, such public service work as we are engaged in, and also in producing the food we eat and the clothes we wear. To those occupied in the management of electric lighting properties it does not seem possible that the movement in favor of municipal operation of electric lighting plants, based upon the assumption that a municipality can produce electricity cheaper than, or even as cheap as, a private corporation, is well founded. We all realize, from the close attention we have to give to our own affairs, that self-interest and the necessity of getting a return on our investment are the first essentials to the economical administration of large enterprises. Ill-advised efforts are often made by legislative bodies to secure advantages in the direction of control which cannot be obtained without giving an equivalent in protection to the industry. This causes the investor to feel that his property is being attacked and compels him to resist such legislation. If reformers will take accurate account of all the points in the problem they will discover that the evils complained of result from errors in legislation designed to determine the relations between municipal bodies and electric lighting companies. It seems to me that the claim that municipal operation is the universal cure for all diseases for which electric lighting companies are supposed to be responsible merely proposes the substitution of political in the place of industrial management. This raises the question: Is the administration of municipal affairs in the various cities throughout this country so economical as compared with the management of private industries and the class of service rendered so efficient as to justify the increasing of the burdens already imposed upon municipal government? It appears to me that a correct division of power and responsibility requires political government to control private industrial management. Where political government and industrial management are merged into one interest, the power of control is seriously impaired, since a political administration cannot be reformed without overturning the party in power.

COMPETITION IS NOT THE TRUE REGULATIVE FORCE.

It is supposed by many who discuss municipal affairs that the granting of competitive franchises for public service work is the true means of obtaining for users the lowest possible price for the service rendered, whereas, as a matter of fact, the exact opposite is the ultimate result. This is proved by results in all large cities where the most severe competition has taken place. Acute competition necessarily frightens the investor, and compels corporations to pay a very high price for capital. The competing com-

panies invariably come together, and the interest cost on their product (which is by far the most important part of their cost) is rendered abnormally high, partly owing to duplication of investment and partly to the high price paid for money borrowed during the period of competition. The selling price of a service should be based on its cost, and in any business such as public work, where the investment is large and the annual turn-over is comparatively small, if the item of interest be unnecessarily augmented, it must be reflected in the price paid by public and private users.

TAKING PRIVATE PROPERTY FOR PUBLIC USE.

Another point that should be included in a proper scheme of public control is a condition under which the municipality would have the right to purchase the undertaking. Such a right should include a direct obligation on the part of the municipality to purchase the property at a fair price whenever it is thought desirable that the industry should be operated by the municipality. The possibility of the exercise of the right of purchase by the municipality would of itself make it to the interest of the owners of the property to do their full duty in their relations to the public. On the other hand, if a community licenses a corporation to perform a certain public service, and if that corporation invests its money and develops its business, surely it is unfair for that community to go into the same line of public service work itself without first purchasing the existing plant. If this is not done the value of private property will be destroyed without just compensation being made therefor in an attempt to secure a public benefit. I do not believe that the people as a whole are so unfair as to demand that such a course shall be taken.

My recommendations on the subject, which I have just presented, are by no means original. Most public service corporations in Great Britain are run on practically the bases indicated, and in more than one State in the Union corporate legislation has taken the same direction.

I would summarize the position which I think we should take on this subject in just two sentences.

First—Franchises granted to public service corporations should secure them the same degree of protection in their rights to their property as is enjoyed by other investments.

Second—Public control of charge for service based on cost plus a reasonable profit, and eliminating the factor of competition, is the proper safeguard for the interests of users, taxpayers and investors.

Public Lighting in Relation to Public Ownership and Operation.*

BY ALEX. DOW.

This paper is written to set before the association a proposed policy. It is not a new policy in its parts, neither is it an untried policy. It is applicable immediately to public lighting; that is to say, to the lighting of streets and public places under contract with, or on account of, a municipality. Ultimately its application may be more extensive.

It is the belief of many members that the National Electric Light Association should formulate and publish a well-considered method of dealing with this business. While local conditions differ, there is no local difference in the principles which should govern electric lighting companies in their dealings with municipalities and municipalities in their dealings with electric lighting companies. An authoritative statement of these principles is needed. A statement by the association may be accepted in the first place only by the electric lighting companies, but if the principles so stated are intrinsically correct, their acceptance by the municipalities must follow. No city government will persist in a course that is plainly inequitable.

A CHAPTER OF ELECTRIC LIGHT HISTORY.

In the history of street lighting by electricity no chapter contains more profitable matter of study or for illustration of general principles than that which contains the record of the city of Detroit. That city was one of the first to use electric lights on its streets. It began in 1883 with twenty-two arcs, and in 1884 abandoned all other street lights. This street lighting business was believed by those who first engaged in it to be a monopoly secured by patent rights; they found their mistake after much money had been invested under that belief; competition ensued; then consolidation, and finally municipalization of the service.

In February, 1896, the city of Detroit owned 1500 arc lamps and was operating 1492 of these in the work of street lighting. In the same month the successor of the Brush Electric Light Company, which installed the original twenty-two lamps in 1883, and which, until 1890, lighted the streets under contract, owned 1049 arc lamps, and used in private lighting 433 of that number. Another company, organized in 1890 to compete with the Brush Electric Light Company, owned 1330 arc lamps and was using in private lighting 38 of these. In each case there accompanied the arc lamps a sufficient number of dynamos, engines, boilers, etc., and a building fully equipped for the operation of the number of lamps stated. At the same time the city had in use 134 towers, which had been formerly owned by the Brush Company, and the other company was in the act of taking down and removing from the streets 104 similar towers, which had formed a duplicate of the Brush Company's equipment. The necessary lines to connect lamps distributed over a large city had been owned by all three. The city had in use 329 miles of overhead wires, connecting to its 1492 lamps. Neither of the companies had owned such a great mileage of line, but one had taken down lines and poles which had supplied 719 lamps, and the other was in the act of removing lines and poles which had connected in 1279 lamps.

Some of the Brush Company's street lighting equipment had been during the preceding five years diverted to the supply of commercial lights. Nevertheless, two-thirds of that equipment is to the present day a useless asset. Lamps which were bought at $40 have proved impossible of sale at one-tenth of the price. Dynamos which cost $2400 cannot be sold to-day for $240. Lines taken down returned only a small percentage of their cost to the treasury. The towers which this company sold to the city did not bring their original price—that goes without saying—but they brought a fair price.

The loss of the second company was greater. Changes in the business had made their street lighting arc lamps unavailable for commercial use, or almost entirely so. Similar changes had made their dynamos a slow asset. The engines were partially diverted into commercial service and the boilers entirely so. The wire taken down was not of a size that would fit in to their commercial lighting system, and the poles hardly paid for the labor required for their removal. The 104 towers—one of the heaviest of all the original expenses—had to be sold as scrap iron.

It is clear that a loss to some person or persons was involved in conditions which reduced machinery and lines capable of supplying over 2000 arc lamps to approximately their junk value. Leaving out all questions as to personal fault—neither affirming nor denying that the loss fell upon those for whose economic blunders it was the inevitable punishment—it is certain that there was a loss to the community at large; that property which might have been and which had been capable of doing good service to the public was as surely destroyed as if it had been swept out of existence in a great fire.

It may be asked on whom did the loss fall. In social economy the loss of one is the loss of all, but to our customary modes of thought there appears a difference between losses borne by ourselves immediately and those which are apparently borne by other people. In this case the greater part of the loss was borne by business men of the city of Detroit. It was a reduction of the available capital of men engaged in productive industry in the city. This reduction—this absolute loss—after correcting for inflated values which should have been written off long before the period of liquidation; after correcting for securities issued for cash at less than their face value, or for considerations which were valued at more than their true worth, was not much less than $400,000.

I do not ask you to sympathize with the immediate losers, but I ask you to remember as my argument proceeds that this loss came about in consequence of business methods and of social tendencies which are in active operation to-day in nearly every town represented in this association. And I submit as a principle not admitting of dispute that the duplication of an effective equipment for public lighting is an economic error, entailing loss of available capital to the extent of the duplication.

In the absence of some other acceptable means of setting a proper price for public lighting by contract, public opinion will not tolerate the suppression of competition.

Would the public of Detroit, after the agitation for municipal ownership had become general, have approved of award of a contract at a low price, or would it have insisted on municipal ownership as a matter of principle? An answer to this is merely an expression of opinion, but I believe that had a low price been offered the agitation for municipal ownership would have been suspended and that the companies might have secured terms more to their interest than was the action actually taken.

There is no longer any question of the right of a municipality to

*Abstract of a paper read before the National Electric Light Association, Twenty-first Convention, Chicago, June, 1898.

own and operate its own public lighting plant. Electric street lighting is a distinctly public service, which must be provided for by the municipality. It is a service to every citizen; is a sequence of the social conditions which constitute city life as distinguished from rural life, and can only be effectively performed on municipal account and under municipal control. Herein it differs from the electric lighting of private premises, and it is necessary to note the difference. Electric lighting is the cheapest as well as the best light for streets and public places. For private premises, on the contrary, electric light is not a cheap light under usual conditions. It is not now, and is not likely to become, an illuminant of universal use, to the exclusion of gas and oil. Why this is necessarily so is well known to the members of the association. To the general public it is a statement better proven by a couple of good examples than by a long statement of causes. In the city of Detroit there were, in 1897, according to the annual report of the Water Board, 54,945 "families." There are in the city of Detroit approximately 18,000 customers for illuminating gas, and 4000 customers for incandescent electric light. It is safe to say that the remaining three-fifths of the possible customers use kerosene oil. The main cause of the use of oil is its lower cost.

The city of Glasgow, Scotland, owns and operates its gas works and owns and operates its electric lighting plant. Neither of them is intended to make a profit. The Glasgow price for gas is 52 cents per thousand, and the Glasgow price for incandescent lighting is equivalent to gas at $1.35 at the maximum rate, and 56¼ cents at the minimum rate. I think this example from a city where municipal ownership has been most thoroughly exploited, and where the municipal management is above suspicion of inefficiency or corruption, proves beyond question that electric lighting for private use is a luxury, and as such must continue to be used only by those who can afford luxuries; that is to say, by a minority of the citizens of any municipality; not by a majority, much less by every citizen.

Therefore, while it is admitted that the lighting of the streets is truly a public service, which may be performed by the municipality for and on behalf of every citizen, the furnishing of electric light to private consumers is not a public service, but is essentially a service to a few individuals, and as such should not be undertaken by a municipality whose object is to perform only those duties which municipal society as a whole owes to itself as a whole. This principle should be clearly understood, and should be boldly maintained. It is necessary that a municipality shall undertake certain services, and it is possible that it may undertake others, but the propriety of its undertaking any service depends on whether that service is to the public or to individuals; to the many or only to the favored few.

THE POSSIBILITY OF LOW CONTRACT PRICES.

This leaves to private enterprise the supply of electric light to private consumers. In performing this service there will be built and equipped a power house; there will be organized an operating and a managing force; there will be constructed lines of distribution. All of these may be, and part of them certainly will be, adapted to the performance of public lighting, in addition to the service of private consumers. To whatever extent this double adaptability exists in the private plant, there will be duplication of equipment in any other plant separately established for performance of the public work. Moreover, it is peculiarly characteristic of public lighting operated all night that its addition to the ordinary work of a private lighting plant tends to reduce the average cost of the combined output. In these considerations rests the possibility of a contractor profitably performing public lighting for a city at or below the price at which the city can itself do the work, and yet it being to the interest of the contractor to undertake the business.

Let us for a minute assume that municipal engineering and management and municipal financing can be just as good as private engineering and private financiering. If they are not so, it is the fault of the municipality, because technical and financial skill and executive ability are for sale in the labor market and are purchasable by a municipality, even as they are by private employers. There remains only one evident cause which should tend to make the costs of a municipal plant differ from that owned by an individual or a company. That difference is that the individual proposes to make a profit and the municipality does not. Looking closer at the facts, we find that the municipality must in most cases allow the equivalent to a profit, because a municipal plant is built by money borrowed at interest. In the case where the money is not borrowed, but raised by direct assessment, the municipality has prevented some of its citizens from profitably using the money taken from them by taxation to be invested in the lighting plant, so that even in the exceptional case the possible profit to the taxpayer on the money withdrawn from his business has to be considered. But the rate of interest on municipal bonds is usually less than the rate of profit which a private owner is willing to accept on money invested in the electric lighting business. It is 4 per cent. as against 6 or 7 or 8 per cent. In the final analysis the difference between the cost of lighting by contract and that of lighting at cost by a municipally owned plant should not exceed 4 per cent. on the capital invested in the plant. I assume in making this statement that the rate of interest on city bonds is a fair measure of the profit that investors expect on a secure investment. If the investment in an electric lighting plant were equally secure, the rate of interest necessary would be no greater. The security depends so largely on the policy of the municipal authorities that it may approximate to that of municipal bonds on the one hand; or, on the other, it may be of the same order as the stock of a speculative gold mine or a Klondike expedition. In saying that the difference should not exceed 4 per cent., I am to be understood as implying such conditions as take the investment out of the speculative class. I am also to be understood as implying that proper salaries for management have already been paid out of earnings, and that the profit mentioned is that payable to capital alone; in other words, an exact parallel to the payment of interest on a municipal bond.

It follows that if the organization and equipment of an existing plant engaged in the supply of electric light to private consumers is available for the purpose of performing public lighting, this maximum difference of 4 per cent. can be thereby reduced or even reversed. In every case the difference should be reversible. There are causes to be considered later which tend to the contrary, but the fact remains that there is no irremovable cause why an existing electric lighting plant should not be able to perform public lighting at a less price than the municipality can do the work itself.

Of the causes which tend to the contrary, one is that the plant which has a contract for public lighting may have very little private service, or none at all. Some other plant in the same city may do all or most of the private business. This condition of affairs can be only temporary. The consolidation of the two plants is an economic necessity, certain to arrive in time. The only condition justifying the existence of two plants in the same city is that the city is so large as to make a division of territory desirable; and even in that case an operating agreement is to be preferred to complete independence.

The public has been told that consolidation of plants is not to the public interest. This is an error, and the way to prove it such is to give to the public the surplus profits of consolidation in the shape of lower rates and better service—either or both.

Another cause tending to handicap the contractor is that few municipalities will make contract for a long term of service. Even the advocates of municipal ownership who are willing to issue twenty or thirty-year electric light bonds, and who will not write off more than 3 or 4 per cent. for depreciation of plant in making their estimates of city operation, will protest against a contract running more than a year or two. They claim for the municipal plant all the advantage of a secure investment, and simultaneously deny these advantages to the contractor. We know that the securing of a long-term contract permits the installation of the most economically operated machinery, and reduces the percentages of profit, which must be earned annually. The objection to the long contract, that it denies to the city any share in the profits of possible improvements effected during the term of the contract, can be met by so drawing the contract that the margin of profit shall plainly be reasonable to begin with, and that the city may share in the results of improvements in consideration of guaranteeing a similar reasonable profit on the investment to be made in such improvements. A ten or twenty year contract with such a clause could be safely taken at a very low price.

A possible solution of this problem is city ownership of the plant, combined with operation by a contractor. I think that this plan may by and by become common. It involves too many details to permit of my discussing it at present.

The very worst handicap that a contractor may have to carry is excessive capitalization. Here it must be noted that many municipally owned lighting plants do not report all their capital expenditure, so that in carelessly made comparisons of fixed charges the contractor appears to have overstated his investment in order to increase the apparent cost of operation. Any comparison must be on an identical basis for capital as well as for operating charges. And for the purpose of adjusting prices between municipality and

contractor, only one basis for capital charge is acceptable; namely, the present value of the plant in brief, a properly made inventory. This proposition is so radical that I state the reasons for it.

The possible bases for a capital charge are as follows: First—The face value of the securities issued by the plant. That this is an impossible base of adjustment is too well known to all electric light men. Second—The current market value of these securities. This is impracticable, because many securities are not on the market, and because the immediate earning capacity of a plant affects the price of its securities, and because—last, but not least—some securities are speculative rather than industrial. Third—The actual cost of the plant. This would be proper if all plants had been built at the same time and if no plant had been obliged to be rebuilt. As it is, the construction cost of two plants built, the one in 1888 and the other in 1898, the two of identical capacity and of similar type, may be to one another as two to one; the earlier plant may have cost twice what was paid for the later, solely because of the reductions in the prices of machinery and material of construction in the last ten years.

The only remaining possible base for a capital charge is the present value of the plant; and I do not think that any other can be made acceptable for the specific purpose of adjusting a price for public lighting. It does not follow that the capital account is to be readjusted to a corresponding figure. It is only requisite that the company accept as a proper profit on public lighting business an allowance based on inventory value of the investment. It would be well for the industry, however, if all our capitalizations were brought near to present values. And one good result of revaluation would be a logical sequence—the depreciation of the investment from year to year would necessarily be admitted as a proper charge against revenue. If a profit is only to be allowed on capital sufficient to construct a plant at the comparatively low construction prices now ruling, any further decline in cost of construction must be considered an impairment of capital, to be made good before any profit can be paid. It is not to be understood that I expect an electric lighting company to stop dividends or to reduce capital stock in order to make good in any one year an extraordinary depreciation charge, due, for instance, to the replacement in the year of old type machinery with new, in order to meet a public demand for a higher grade of service. Such extraordinary charges must be financed according to well understood rules. The loss of value of the old machinery does not occur in an instant, but is a process continuing through several years. So far as it is possible, this loss of value should be anticipated by charges made in advance—in other words, by the accumulation of a renewal fund. But where this has not been done the charges should be distributed over a proper period with due regard to all interests involved—in other words, so as to secure the greatest good for the greatest number. The principle is all important. The detail as to how a proper depreciation charge shall be put on the books is a matter to be disposed of in the most convenient manner.

IN CONCLUSION.

Having recited my premises, I now state my proposed policy as a recommendation, as follows:

I recommend that the association declare by resolution:

1. That a municipality may properly provide for public lighting either by the ownership and operation of an electric lighting plant, by the operation of a contractor under lease, of a municipally owned plant, or by contract with the owner of a private plant.

2. That the supply of electric light to private users is not properly a municipal function.

3. That the performance of public lighting under contract by a private plant in connection with the supply of electric light to private users is essentially the method of least expense.

4. That the existence of two electric lighting plants in the same territory is an economic error, tending to increase the cost of production, and thereby the selling price; and that the maintenance of competition is to the detriment of the public.

5. That public lighting by contract should be performed at the lowest price consistent with a reasonable profit on the value of the investment; that no electric lighting contractor should demand more than such a profit, and that each municipality should protect the contractor in the enjoyment of his profit, and against impairment of his investment, in order that a minimum profit may become reasonable.

6. That in order to adjust prices in the absence of competition it is necessary that costs be ascertained and prices approved by a competent authority, acceptable to the public as well as to the contractor.

7. That in the absence of a constituted authority competent to ascertain costs and prescribe prices, members having public lighting contracts under consideration should endeavor to have the adjustment of the contract price undertaken by a temporary commission, or arbitration committee, who will adopt as the basis of adjustment the principles set forth in these resolutions, particularly in resolution No. 5.

8. That there is no essential difference in the organization of municipally owned plants requiring a different analysis of costs from that which is proper for private enterprises, and that the publication of the costs of municipal lighting plants properly analyzed is beneficial to the electric lighting industry. Further, that the similar publication of the costs of private plants is desirable, but is at present impossible, because of its advantages to actual or possible competitors.

In conclusion, I desire to say that the tendency of public opinion appears to be toward some interference by and on behalf of the public with corporations performing so-called public services. Such a tendency is a concomitant of our social progress. It is not merely a temporary surge, but is a part of a general movement. It cannot be withstood, but may be guided into proper channels. The general result of any such movement is for good; the damage which is done to individual rights is incidental and is more often the result of needless opposition by the individual. In this matter of public lighting the right of the community to interfere is so evident that it has been one of the first subjects considered, and will be one of the first disposed of; and its priority in time will establish its disposition as a precedent for the future disposition of similar questions. There is immediate need for clear thinking and for well considered speech and action—for speech telling the public that electric light companies desire to do business according to the golden rule, and for action plainly in conformity with the speech. I believe that this association can appropriately speak for its membership, and that its members are willing to live up to the principles which the association may enunciate.

General Distribution from Central Stations by Alternating Currents.*

BY HERBERT A. WAGNER.

Ever since the installation of the first few pioneer alternating-current central stations, just ten years ago, we have heard it predicted with persistent reiteration that for the distribution of current for lighting from central stations direct current was a thing of the past, and that in a few years the alternating-current transformer system would hold the field without a competitor.

To many this prediction may seem to have been fulfilled, considering the enormous number of alternating-current plants, compared with direct current, that have been installed, and the remarkable impetus given to electrical industries by the development of alternating currents. The great success achieved in the transmission of power by polyphase-alternating currents in the last three years, has but strengthened this general belief, and left fewer champions to adhere to the direct-current cause.

These great achievements have led the enthusiast to think all progress confined to alternating systems of distribution. Deeper investigation, however, shows that while in point of number the alternating-current stations, reaching into the thousands, completely overshadow those of direct current, there are few really large stations, outside of water-power plants, that are to-day employing alternating current for distribution, and that while enormous investments have been made in direct-current stations in our larger cities, comparatively small amounts have been invested in alternating-current work.

I may startle many by stating frankly the discouraging fact, which has been barely whispered at times, that, judged by the standards of the magnificent Edison properties in many of our larger cities, few alternating-current central stations in the United States have been a success. The fault lies, not with the alternating current itself, but with the method of its application.

The early alternating-current stations were installed on the principle that the drop in lines with distribution at 1000 volts was practically negligible. Two wires were run out from the station, pass-

*Abstract of paper read before the National Electric Light Association, at its twenty-first convention, Chicago, June, 1898.

ing along those streets where light was to be furnished, and lights were connected at any desired points between the station and the farthest end, without reference to such trifling considerations as difference in potential. Distribution was attempted in this way for years, and in many places is still in operation. Lines are even being constructed to-day without any notion of a system of feeders and mains, although an almost perfect system for the maintenance of uniform pressure was in operation in many Edison stations before the first alternating station was in existence. Fortunately for the operators of such models of simplicity, the current delivered has usually been so small in quantity that with the proverbial No. 6 wire, which seemed to possess virtues not affected by distances, the difference of pressure between neighboring customers rarely exceeded 10 per cent.

The regulation was all effected by means of the dynamo field rheostat, and the pressure indicated by a voltmeter on the secondary of a transformer whose primary was connected to the bus bars on the switchboard. A few lamps were also often operated by the same transformer to light the switchboard or other parts of the station. The station attendant was, of course, in absolute ignorance of the pressure at any point on the lines where lamps were used. The pressure was therefore usually run high enough to be on the safe side.

Later a compensating voltmeter was produced that could be adjusted for any drop in the lines. It was ingeniously arranged so that a small series transformer in the main line would send currents opposing those operating the voltmeter, thereby making the needle or index drop back approximately proportionately to the current in the line. This device was a great help, and caused the drop in lines to jump into prominence at once. It would be quite perfect if the drop in alternating-current lines were proportional to the current, but it is not. The power factor of ordinary alternating-current systems is usually quite low at light loads, and, except with very small wire, an ampere may therefore produce much more drop proportionately at light load than at heavy load.

The usual system of distribution provides a separate transformer for each customer. In many cases, this implies the use of a very small transformer. It is impossible to make the efficiency of small transformers high. As each customer may at times use all of his lamps, he must have full transformer capacity for such an emergency. The ordinary ratio between maximum station loads and the number of lamps connected is in most cases under 50 per cent. where meters are employed. The transformers then, being of a total capacity equal to the number of lamps connected, average at best only 50 per cent. of their rated capacity at the maximum station load. In most stations the average load generated is much less than 25 per cent. of the maximum load, and, therefore, with twice the transformer capacity of that represented by maximum station load, the average transformer load would not exceed 10 per cent. of the transformer capacity, all the year round.

The efficiency of the average modern transformer of usual size at 10 per cent. of its rated load is not over 65 per cent., and the average of transformers at present in use not more than 50 per cent. It is perfectly safe to say that there is not an alternating-current station to-day using individual transformers for each or neighboring customers that can show an average efficiency of distribution of over 60 per cent., and few that can show over 50 per cent.

In Europe it is, to some extent, the practice to use transformer sub-stations with low-potential distribution from these points. Transformers are cut in and out at these sub-stations by attendants according to the demand for current. It is doubtful if, after paying interest on the investment in property and housing for these transformer stations, together with the investment in instruments and switches required, and the attendants' wages, there is very much saving effected. Had we nothing better to turn to than these systems, the cost of distribution from large stations would be extreme compared with the direct-current, three-wire system, and competition with the latter could not be a success.

Another important consideration is the efficiency of lamps used. To employ successfully the highest-economy lamps a very uniform pressure must be maintained. With the usual alternating-current system, and with an equally good disposition of feeders and mains, the variations of pressure will exceed those in a direct-current system by nearly 3 per cent., on account of the transformer drop, and to secure even this limit of variation pressure wires must be used with each feeder. It is not surprising to find, therefore, that almost all alternating-current stations are using lamps requiring 20 per cent. more current than those used by direct-current stations.

I cannot refrain from remarking here that to operate any station, alternating or direct current, without pressure wires, is to be worse than penny wise and pound foolish. In any alternating-current station employing overhead wires, the saving in lamp renewals would equal the cost of pressure wires in little over a month's time. I might also add that the total loss of lamps is not the most serious result of variations in pressure. Such variations cause a rapid decline in candle power, and low candle power means disaffection of customers and the increased use of gas.

On the plans of the system of distribution of a low-tension direct-current system a remarkable network of feeders and mains is laid out, most carefully calculated for the maintenance of uniform pressure. Means are provided for regulating more or less independently the pressure on each feeder. From numerous points in the system, corresponding to the feeder terminals, pressure wires are brought to the station, and indicators show the pressure at all these points.

The necessity for using an enormous amount of copper and for locating stations near the centres of distribution are the only weak points of this beautifully developed system, and the alternating current advocate had best endeavor to overcome those particular points and adopt the rest, instead of starting out anew and alone to develop another system from beginning to end. It is not too late, however, to begin afresh. At the present time the Edison three-wire system of distribution is the most efficient in use and the most nearly perfect in details. The usual system employed with alternating current is not efficient and does not admit of as close regulation, but it is vastly cheaper to install.

Comparing the cost of individual transformers and high-potential distributing mains with the three-wire system of mains at low potential, there is not a great difference in first cost in favor of the alternating. The direct-current feeders do, however, for the same distance cost about thirty-one times as much as those for alternating current at 1100 volts, 125 times as much at 2200 volts, or 500 times as much at 4400 volts. It would then appear that if we could apply alternating current to the feeders at high potential and transform down for the mains, we might reach the lower first cost of the ordinary alternating-current system and possibly retain all the best features of the direct current. To accomplish the former the transformers must be provided at a small proportion of the cost of the alternating-current feeder, and to do the latter they must not increase the average losses in the system. It is obvious that we could with alternating current move our station to any reasonable distance from our centre of distribution, and at comparatively small additional cost for feeders. The whole problem then seems to come down to transformer efficiency and means of regulation.

To consider the matter of regulation first. We see at a glance that we cannot use the direct-current method of regulation by supplementary bus bars, but we can use the booster method, and can, moreover, apply a static booster to each feeder to regulate within any desired limits and with as small gradations as necessary. In fact, the booster method of regulation was first applied to alternating-current distribution, and operates with much less average consumption of energy than either the supplementary bus or direct-current booster method. In this important consideration we can therefore improve on and simplify direct-current methods.

The means of regulation having been in this way provided for the feeders, it remains to be considered what we shall do to eliminate the effects of transformer drop. As we have determined on a secondary low-potential, three-wire distributing system of mains, we can altogether dispense with high-potential mains and limit the high potential to the feeders. If we do this, we can conveniently have the transformers of the same unit capacity as the feeders, and arrange each with its primary connected to its independent feeder and its secondary feeding into the three-wire mains. We know that the effects of our feeder drop are eliminated if we regulate by pressure wires from the feeder ends. In the same way the effect of our transformer drop may be eliminated by bringing pressure wires from the secondary terminals. The feeder drop and transformer drop therefore become one, and are cared for in the same way. We can even secure better general regulation than with the direct-current system, as we have a better form of feeder regulator and have eliminated the effects of transformer drop.

Now, to return to the transformer itself and its efficiency. It is evident that, with this system, the transformer capacity need be no

greater than that required for maximum station load, instead of more than twice that amount or nearly equal to that required for the total number of lamps connected. This at once doubles the average load on our transformers, and raises the average efficiency. It also incidentally reduces the first cost of transformers in still greater proportion. We also know, however, that transformer efficiency at light loads is dependent on the iron loss, and that this is interdependent with the regulation or drop. If we can increase the drop, we can decrease the iron loss, and thereby greatly increase the average efficiency. Having provided against any interference with the regulation of the system by the transformer drop, we can afford to increase that to the heating limit of the copper. In this way, a 100-kw transformer can be built with an average efficiency of over 98 per cent. The entire transformer loss can, moreover, be more than made up by the reduced loss in feeders, which we would naturally have with alternating current.

It has been my good fortune to have an opportunity to install a system of this kind on a large scale, which is now in very satisfactory operation. It is laid out exactly as a three-wire Edison system would be, except that there are no sub-feeders. A network of mains is planned as if for use with direct current. The feeders are all designed for 110-kw maximum load at 1100 volts, and at each feeder end is placed a 110-kw transformer feeding into the three-wire network in the same manner and at the same points as with the direct-current system. The transformers are located in manholes of suitable design. From the secondary terminals of each transformer pressure wires are run back to the station. Each feeder has an independent regulator by which the pressure can be raised or lowered. There are no primary mains, nor any connection whatever between the primary feeders. The regulators perform two functions. They are used to maintain the proper pressure as indicated by the voltmeters and also to divide the load between transformers in any way desired as indicated by the feeder ammeters. It is possible to shift the entire load from one transformer and feeder to an adjacent transformer in this way without sensibly affecting the pressure on the system, and an equal division of load between transformers can be readily maintained at all times if desired. The distribution of load on any large system is constantly changing as new customers are connected, and in large Edison stations certain feeders often become so overloaded that it is found necessary for their safety to put resistance in series with them to force some of the current to other feeders. The possibility of overloading any individual feeder beyond its share is absolutely provided against in the system described.

In Fig. 1 are shown four curves of station distribution efficiency. No. 1 is that of a representative Edison three-wire, direct-current station. No. 2 is the new alternating-current system described. No. 3 is the usual alternating-current system employing separate transformers for each customer or for adjacent customers, the best modern transformers being used. No. 4 shows the same system, but with the average transformers found on the lines of most existing stations. These curves were plotted from the following data obtained from actual practice:

	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent.	No. 4. Per cent.
Feeder loss	24	8	10	10
Main loss	2	2	2	2
House wiring loss	1	1	1	1
Transformer loss, iron	..	.23	6	12
" " copper	..	2.7	1	.5
Total loss at maximum station load	27	13.93	20	25.5
Efficiency at maximum station load	78.7	87.9	83.3	79.6

The efficiencies of distribution at assumed average loads are shown to be as follows:

Per cent.	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent.	No. 4. Per cent.
Load, 25	94.1	95.8	78.4	66.6
Load, 20	94.8	96.2	75.3	61.4
Load, 15	96.1	96.5	70.3	54.3
Load, 10	97.3	96.4	61.9	45.1

At maximum load it will be noticed that the efficiency of alternating current No. 2 is 10 per cent. higher than No. 1, the direct current. This means that the same energy can be delivered with 10 per cent. less capacity in generators, engines and boilers, or a difference of 10 per cent. in the first cost of generating plant. It is pertinent to remark here that alternating-current generators also have a much greater margin for overload for short periods than direct-current generators. The efficiency at average load, or the all-day efficiency of the No. 2 alternating-current system, is also shown to be appreciably higher than the direct current. In large central stations the average load is generally found in practice to vary from about 15 to 20 per cent. of the maximum, and it will be noted that from 12 per cent. average load up, No. 2 curve for the special system of alternating-current distribution shows a higher efficiency than the direct current.

It may be asked what effect the aging or fatigue of the transformer iron will have on these figures. I answer, none appreciable. Transformer manufacturers are willing to guarantee as low as 1 per cent. increase per year in iron loss. This means 1 per cent. of the actual amount of energy lost in the iron, so that, if this increase continued at the same rate, it would take 100 years to double the iron loss. Experiments tend to show, however, that this effect rapidly approaches a maximum, and that, therefore, the increase goes on at a constantly decreasing rate. The entire effect may be

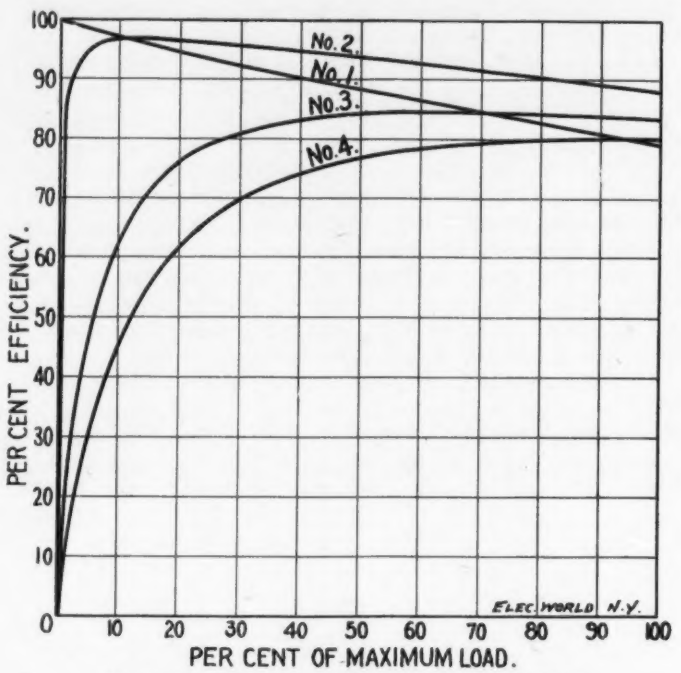


FIG. 1. CURVES OF DISTRIBUTION EFFICIENCY.

eliminated, if desired, about once in five years by reannealing the transformer iron at a very small expense.

It has been the practice in some European stations to cut out transformers during periods of light load, but it will be seen that cutting out transformers in the system described would only decrease the efficiency; in fact, the efficiency is higher at about the average load, and the system was designed throughout to accomplish this result.

EXTENSIONS OF DIRECT-CURRENT SYSTEM BY ALTERNATING CURRENT.

Several large three-wire, direct-current stations are beginning to employ alternating current to extend their lighting territory beyond that possible or profitable with low-tension current. This is a recognition of alternating current which would not have been considered for a moment a few years ago. They now propose to use alternating current to transmit their energy at high potential to a distant sub-station, where it will be transformed to a lower pressure and then again transformed by means of rotary transformers to direct current, which is in turn distributed over the three-wire Edison system as if generated in the ordinary way. This is a very beautiful and instructive application of alternating currents and ingeniously designed machinery. It gives the manufacturers a chance to sell additional machinery, swells the company's real estate investment and gives work to the unemployed to operate the sub-stations.

The loss in the conversion to alternating current and back is about 15 per cent. in addition to the loss in static transformers and lines. This distribution might be accomplished without the additional machinery, wire, real estate, labor, and loss in efficiency. It is hardly to be expected, however, that those who have grown up

under the protection or influence of direct current would use alternating current any further than absolutely necessary until they have grown more accustomed to the new mode of travel.

A much higher efficiency of distribution and better regulation could be secured by using the alternating-current system as it is, without transformation to direct current, and everything could be controlled from the main station without employing labor or apparatus at sub-stations. Why do they not use it so? They say that many things cannot be accomplished as well with alternating current. If that is a challenge, we will accept it and try conclusions with them. Let us then anticipate these various objections and see what they amount to.

Efficiency—We have already seen how a properly designed system of distribution for alternating currents may be made to exceed the direct-current system in efficiency, taking the latter under its most favorable conditions. If we then add to the usual losses in the direct-current system the losses in double rotary transformation and in static transformers, the very great difference in favor of the alternating current is still more marked.

Regulation—It has been shown how very simple and reliable regulators can be provided for each alternating-current feeder, which will secure the closest possible regulation over any range desired, and this can be effected at a loss of less than 1 per cent. Such close regulation can only be secured with direct current by the use of a number of generators connected to auxiliary bus bars, or by connecting the feeder ends to adjustable resistance connected between the busses of two or more generators. The first cannot be realized in a rotary-transformer station, and the last is quite wasteful of energy. Regulators placed on the alternating-current feeders of the rotary transformers control alike the pressure on each rotary, and all the direct-current feeders supplied by the same, in exactly the same way as field regulation does on a direct-current generator. Such regulation can only be effectual with a number of small rotaries not operated in multiple. The best regulation can, therefore, undoubtedly be secured with the alternating-current system.

Operation of Arc Lamps—It seems now to be the universal opinion among Edison station men that the enclosed-arc, long-burning lamp is destined to replace all the old forms of arc lamp. We will, therefore, consider this type of lamp only. Fully as well-burning lamps of this type are now made for alternating current. They are also about as free from noise as the direct-current lamps. Many will say, however, that it is impossible to get as much light from the alternating current as from direct current. That is true if we state that the same energy in the arc produces less light with alternating current than with direct current. It has been determined that the alternating-current arc produces about 70 per cent. of the light to be obtained from the same number of watts in the direct-current arc. The usual direct-current enclosed arc requires five amperes at 115 volts, or 575 watts. How much of this is used in the arc? Somewhat less than 80 volts, or under 400 watts; the balance of over 175 watts being wasted in resistance.

With alternating current, 70 per cent. of the amount of light would be obtained with this 400 watts, or about 570 watts would be required to produce the same light. The alternating-current arc is best operated at about 70 volts, but inductive resistance is used to bring the pressure down to this amount. This inductive resistance consumes about ten watts' actual energy, making in all 580 watts, against 575 for the direct current for the same amount of light. This difference of five watts, or less than 1 per cent., is insignificant.

Motors—The greatest argument used against alternating current used to be that it would not run a motor. It has long ago proved that it can, and that without a commutator. This subject now brings us to multiphase systems. There are two of these systems in general use, the two-phase and the three-phase. Other systems are but modifications of these and will be mentioned as such. Motors can be operated with equal facility and efficiency on either system and have many distinct advantages over direct-current motors.

For long-distance power transmission the three-phase system shows an economy in copper; but for lighting, or for lighting and power combined, it is not at all well suited. I might say that where lighting is a distinct feature, and first-class service is to be rendered from a large station, the three-phase system cannot be used successfully. On even the best generators, the windings are so entirely interdependent that a change of load on one phase will affect the pressure on the other two; but a defect even worse is the impossibility of regulating the phases independently for drop in the feeders if the load happens to vary differently on any two. Any regulator placed in circuit with one phase will effect about the same change of pressure in the adjacent phase within the usual limits of regulation. Regulation is then a question of the best possible averages, and at best is but guesswork. With the feeder and transformer drops found economical in practice, it would be practically impossible to keep the pressure sufficiently constant for high-efficiency lamps. The complication of wiring is also very serious, especially if the Edison three-wire system is used for distribution, as six wires would then be required, forming six circuits that must be kept balanced.

The two-phase system is subject to the same objections unless the two phases are used separately for lighting, in which case we have the complication equivalent to twice the number of generators and feeders.

For good regulation and simplicity, the single-phase system cannot be equaled by any multiphase system.

We can meet the direct-current advocates on the power question, therefore, on at least an equal footing, save only one application met in central-station practice; namely, the operation of high-speed elevators. The alternating-current motor, multiphase or single-phase, cannot be controlled for this work as readily as a compound series, direct-current motor. It has taken several years, however, to perfect the mechanism for the control of direct-current elevator motors. Give us the same time and we will do it with alternating current. This field for power has only of late been opened to direct-current stations, and it is yet a question for debate as to whether it is a paying one.

Storage Batteries—Here we come to the direct-current advocate's last and greatest stronghold. To this he retreats with great confidence of safety. We may ask first whether storage batteries have yet been proved to be a valuable adjunct to the central station, cost and maintenance considered. It is true they are being tried by several large stations, and we watch eagerly for the results. They equalize the station load to a greater or less degree, and cut down the generator capacity for the peak. Are they, however, cheaper than generators, engines and boilers of the same capacity? Are the losses in transformation less than the cost of a few more attendants? Is their maintenance less expensive than that of generating apparatus? These questions cannot as yet be answered in the affirmative. But if the battery man's most sanguine hopes be realized, what then? If rotary transformers are good enough for the direct-current man to use to change the direct current to alternating current, transmit a good proportion of his load to a distance and transform again to direct current, why should not the alternating-current man use them to charge his batteries and then to transform their output back to his pet form of current? Loss in transformation, do we hear some one say? Not any more than with our contemporaries' long-distance transmission system, and, in this instance, they are small and unimportant, we are told. There is at least one station in the country where storage batteries are being used in this way, and I believe with success, as storage batteries go.

The great desideratum in central-station practice is to be able to employ one system for everything. All current for all classes of service should be supplied from but one type of generator, be this direct-current or alternating-current. In this way only can the maximum output be accomplished from a given investment in machinery and apparatus and the greatest economy in operation secured. This has been accomplished in many stations where a limited range of service is to be provided. Arc lighting has, of all, been the most troublesome to provide for. How shall we operate our arc lamps from our incandescent lighting system has been the anxious inquiry. The constant-potential arc lamp has answered this question for commercial lighting, but city street lighting cannot be so easily provided for. The Edison companies have done a limited amount of this from their three-wire system, but this can be done to advantage only in districts where mains have been provided for commercial lighting. For extended arc lighting, the small-series machine with its belts and clutch pulleys still holds the fort.

I am able to state, however, that one large company has recently solved the problem to its entire satisfaction.[1] This company furnishes 2600 street lamps to the city, lighting some 300 miles of street. These were operated by a small army of series arc machines. They were installed by a company that was acquired by purchase by the one first mentioned. As this company had long since adopted alternating current for its entire distribution, it was extremely desirable to be able to operate these city lamps from its large direct-

[1] See THE ELECTRICAL WORLD, June 11, 1898; pages 717, seq.

connected alternators, thereby saving in fuel, attendance, floor space and reserve investment.

After a few months' trial of an experimental circuit with alternating current it was found perfectly feasible to operate the same direct-current lamps, slightly remodeled, on the same circuits of sixty or eighty lamps in series. A system of this kind was, therefore, adopted and the company now has 2300 of these lamps in regular operation by alternating current in this way. The circuits are each provided at the station with a regular step-up transformer of a maximum capacity of 4000 volts and ten amperes, and the feeders to these transformers are treated on the switchboard in the same way as the feeders for incandescent lighting. It is quite usual for one generator to carry 2000 of these lamps. The lighting is satisfactory to the city and the lamps give better service than when operated by direct current. There has been a very marked saving in fuel and attendance. The indicated horse-power per arc lamp is considerably less than with the direct-current arc lamps operated in the usual manner.

Lachine Rapids Plant and the Cost of Producing Power for Generating Electricity Therefrom.*

BY W. M'LEA WALBANK.

The Lachine Rapids Hydraulic & Land Company, Ltd., was honestly formed, with a bona fide capital of which every share represents $100 cash. This, the writer considers, has a direct bearing on the cost of producing electricity, because a company handicapped by what is called watered stock, or exorbitant promoter salaries, has to pay interest on money it never had the use of.

The hydraulic plant consists of a main dam and power house, 1000 feet long, and a wing dam and guard pier 5000 feet long, forming a head race or basin with an average depth of 12 feet in low water.[1]

To secure this it was necessary to divert the waters of the St. Lawrence and lay bare the bed of the river for a distance of over a mile and remove over 400,000 cubic yards of rock.

The main dam is constructed of a series of isolated cut stone piers, with head gates and stop logs, furnishing in all thirty-six flumes and three waste weirs, at the same time forming foundations for the power house and turbine sheds.

The total development will, when completed, consist of seventy-two vertical turbine wheels and twelve generators. The wheels connected in series of six, by gearing, to a horizontal shaft, at the end of which a generator is directly connected. The completed power house will contain twelve such sets. Of the total installation forty-eight wheels are already in place, and the power house, head race, tail race and dams are completed.

Each dynamo house will contain four three-phase General Electric alternators, wound for 4400 volts at full load, and two direct-current exciters at 120 volts. There will be in the total installation three such dynamo houses, containing in all twelve dynamos and six exciters, each exciter being capable of exciting four machines. Each dynamo house will have its own switchboard, of blue Vermont marble, of the very latest design, so arranged that each circuit may be operated from the switchboard of either power house. The floors are of slate and the building of solid brick. The current is generated at 4400 volts, avoiding the use of step-up transformers, is transmitted on iron poles over bare copper wire to the city of Montreal, a distance of about 5 miles, to the sub-stations, where the pressure will be lowered to 2,300 volts. By means of sub-station switchboards it is sub-divided and distributed, partly through underground conduits and partly by overhead construction, throughout the city of Montreal and its suburbs, where there is a population of over 300,000 people offering a market for light and power. Of the total equipment one-third is already installed.

The wheels were tested at the Holyoke testing flume and developed at full gate 300.84 horse-power, showing an efficiency of 81.32 per cent., which would make the total possible output of our power house about 16,000 kilowatts.

Perhaps the greatest obstacle to a fair comparison of electric current produced by water power, as against the same current produced by steam, is the first cost. In the former case, especially if a large water power is to be developed, the expense of the whole installation, such as dams, head and tail races, etc., has usually been made at the commencement, while perhaps only a fraction of the power thus obtainable is at once used, therefore entailing a very much larger capital cost per unit than with a steam plant, which need only install the power necessary for immediate demand and continue increasing or adding thereto, as the demand therefor offers.

In our own case it was necessary for us to spend about $1,000,000 in hydraulic development. This million dollars will furnish us over 20,000 horse-power, when we can find a demand for it. The 5000 horse-power from a commercial point of view will have, for the present at least, to be charged with all the expense of the hydraulic equipment for over 20,000 horse-power.

In estimating the cost of producing power from the Lachine Rapids, the writer does not take into consideration the cost of distributing power, for this would be the same whether the prime mover was a water wheel or a steam engine. He will therefore confine himself to the cost of developing water power and delivering that power on the bus bar at the sub-station, adding the cost of the transmission from the source of power to the sub-station in the city, because this is directly attributable to water power plants. There will also be included the step-down transformers to bring the pressure equal to that required for local distribution.

It is necessary to give, first, the cost per kilowatt per year for the portion of the plant at present installed and connected to generators ready for operation, and, second, what the cost will be per kilowatt per year when the whole water power development is in operation.

The total cost of water rights, dams, hydraulic machinery, power house, transmission line, step-down transformers, etc., is $957,200. Power developed is 4000 kilowatts at the generator. Allowing 10 per cent. loss, there will be delivered at the sub-station bus bar 3600 kilowatts, which is equivalent to $263.83 per kilowatt, capital cost.

This, at 6 per cent., would be equivalent to....	$15.95 per kilowatt
Depreciation of $300,000, which will more than cover the cost of that portion of the plant subject to depreciation, rated at 5 per cent. and spread over 3600 kilowatts, would be equivalent to (per annum).....	4.17 " "
Operating expenses, including labor repairs, insurance, amounts to $10,275 per annum, which, divided into 3600 kilowatts, is equivalent to	2.85 " "
Making a total cost per kilowatt on a twenty-four hour day basis, per year.....	$22.97 per kilowatt

The total capital cost with seventy-two wheels installed will be $1,113,273.

Power developed with the whole plant in operation after deducting all losses will be 13,500 kilowatts at the sub-station bus bar, equivalent to $82.46 per horse-power capital cost, which, at 6 per cent., represents (per annum)	$4.95 per kilowatt
Depreciation per kilowatt.....	1.68 " "
Operating expenses, including labor, repairs, oil and waste and insurance, if taken upon the same basis as already existing will amount to $20,453, equivalent to.....	1.51 " "
Making a total for a twenty-four hour run per annum of	$8.14 per kilowatt

It will be noticed that the operating expenses, as well as the depreciation per kilowatt, in the latter case are very much reduced, and it is a remarkable feature how constant our operating expenses are, even at present, being practically the same with full load as with no load.

In connection with these figures it might be stated that coal used in Montreal and vicinity is what is known as Nova Scotian coal and costs $3.50 per ton for run of mine.

The writer would also draw your attention to the fact that the capital cost cited in each of the foregoing cases includes money paid for real estate, of which the company owns over some 8,000,000 feet, fronting on the rapids, intended at some future date to form the site of a suburban town, and which it is hoped and expected will return the money expended in developing the water power above referred to.

*Abstract of a paper read before the National Electric Light Association. Twenty-first Convention, Chicago, June, 1898.

[1]For an illustrated description of the plant see THE ELECTRICAL WORLD of October 2, 1897.

Proceedings of the 21st. Convention

Chicago, Ill. June 7-8-9 1898

NATIONAL ELECTRIC LIGHT ASSOCIATION

The twenty-first convention of the National Electric Light Association opened auspiciously on the morning of June 7, at the Auditorium Hotel, Chicago. The city chosen is a little outside of the centre of distribution of central stations if, in their moments, the relative size is considered. Western central stations are, as a rule, comparatively small, and their officers oftentimes unable to spare the time and money involved in the long trip from anywhere in the West to Chicago. For those who could come, however, the occasion was an enjoyable and most instructive one. The subjects and authors of papers were well chosen, and that the papers were received with interest was shown in the discussions.

By far the greater number of delegates were representatives of manufacturing and supply houses. It is surprising what an interest these gentlemen feel in the conventions of their friends. Possibly they desire to get first hand any suggestions the electric lighting men might make in their papers as to the construction of apparatus and the conduct of a manufacturing business, and possibly there are other reasons, but they certainly add to the life and enjoyment of a convention.

The headquarters were well chosen. The meetings were held in the banquet hall of the hotel, which, connected with its annex by an underground passage, gave ample room for all the delegates under one roof and eliminated the necessity of their going out of doors in the rather unfavorable weather.

Perhaps the most prominent feature of the convention was the Chicago Edison Company, on the register, in the programme, and in the discussions. The work of this big system is a shining example of intelligent progressiveness, and every detail asked for was explained with a refreshing freedom from secrecy.

PROCEEDINGS OF TUESDAY, JUNE 7.

The meeting was called to order at 11 o'clock by President Insull, who read the address abstracted in another column, and spoke further as follows:*

"In my remarks just made I have endeavored to touch upon a few subjects upon which I hoped we would have had papers, but I have failed to get members to prepare them. One of these subjects involves the basis on which we exist and the other for which we exist. They are very important matters for us, and I think we ought to take some kind of action in this session in connection with them. I would therefore request the members to keep their copies of the address until these various questions come up for consideration."

The president then read letters of regret at their inability to attend the meeting from A. M. Young, vice-president of the association; Thomas A. Edison, Nikola Tesla, Professor Bovey and Elihu Thomson.

Invitations to accept the hospitalities of the following companies were read: Metropolitan West Side Elevated, South Side Elevated, Northern Steamship Company, asking the members to "inspect" the "North-west." An invitation for the association to meet in Detroit next year was also read. The Chicago Telephone Company announced that it had placed a special telephone in the secretary's office for the use of the members and visitors. The American Telephone & Telegraph Company announced that it had also placed a long-distance telephone at the disposal of the members and visitors.

The president then announced the next order of business to be the paper by Mr. Calvin W. Rice, Brooklyn, N. Y., on the "Cost of the Generation and Distribution of a Unit of Electricity." After the reading of this paper the president suggested that the topic following for discussion, "Prices and Discounts for Electric Current and Methods of Billing Current to Customers," was so closely interwoven with the subject of Mr. Rice's paper that they might both be discussed together.

Mr. Ayer—There is a note in the paper about the losses or unaccounted watts developed in the lighting station, as compared with gas, that the losses are from different sources. It it not a fact that the gas losses are due to condensation quite as much as the watt losses are due to line drop. In other words, is there not in both cases loss in distribution?

Mr. Barker—The occasion for the loss in the gas distribution is largely leakage in the pipe. The condensation loss, if gas is properly made, can be reduced to a very low percentage, and the large percentages of loss in cases about which you hear occasionally are due to actual leakage. We always find where a large system of street improvements is being made, whether upon the surface of the street, in the construction of the street itself or underground, such as the laying of sewers and water pipes or even the laying of underground electrical conduits, that the amount of leakage in the gas pipes and the loss from the amount manufactured is greatly increased. The causes are somewhat different in gas distribution from those in electric light distribution, although it may be that when electric light distribution is as thoroughly understood and as accurately applied the losses may be very largely reduced, as has been the case with gas distribution.

Mr. Coggeshall—The loss of output in our system by alternating current from January 1 to April 1 was 53 per cent.; we collected for 47 per cent. I account for it from the fact that the loss largely existed in the transformers. Our day output is small; we run twenty-four hours the whole year, and as far as we can indicate it the loss in the daytime for about eight hours is equal to 24 horsepower, without receipts to amount to anything.

Mr. Wagner—In that connection I would suggest that the losses may be accounted for in the fact that the meters do not register the full amount of the current which is used. From my observation I would say that the figures are nearly correct for the usual alternating current stations in small cities. The efficiency of distribution is rarely much over 500 per cent., the loss aggregates nearly 60 per cent. With a direct current station it is somewhat less.

Mr. Creden—The Chicago Edison Company generates a kilowatt from about 4½ pounds of coal, which gives an evaporation of about 6 pounds on an average. Coal as used in Budapest would safely give about 10 pounds on an average, which readily accounts for the large number of watts generated.

President Insull—I have here a chart which shows the average cost of various operations in connection with our operating expenses, except the interest portion of the operating expenses. The columns here show the interest charges with different character of load factors. These figures are taken from our actual balance sheet of the year. The largest amount of expenses is general expenses. The reason for that is that one-third of the expense is in getting new business, one-third administrative expenses and the balance insurance, taxes and similar items. The important point that the chart brings out is the interest cost. You might have all of your operating expenses presented to you outside of interest and then you would lose money—it would be possible to do such a thing if your selling price is not on the right basis. Here is a case of a 3.7 load factor. It is an office building, an actual case, not an extreme case. I could show you cases where the load factor would be much poorer than that, but in that case the interest charge is 80 per cent. of the total operating charge. Here is a case of an ordinary fancy store—these cases are taken from the actual bills—and you see there that the interest charge is a little less. The importance of the interest charge in this case will be brought home to you when I tell you that the difference between 6 and 5 per cent. in the price you pay for your money, and whether you sell your bonds at 90 per cent. or sell them at par, makes a difference of 16 to 20 per cent. in the cost of operating expenses. That statement alone will show you that the public (generally) is more interested than we are in the question of protecting us in the enjoyment of our right to do business.

Now we come to the all-night restaurant where the load factor is 48 per cent., the interest charge is only 26 per cent. of the total expenses. In this case you could sell current to a man at about a quarter what you could sell it to some customers, and make more money out of it. You will find that the same relation goes all the way through with the different classes of business. Power business is not quite as good as all-night lighting business. The load factor is about 35 per cent. and the interest expense 32 per cent. With a dry goods store the interest is about 40 per cent. With a small lunch counter the interest is 45 per cent., and with a saloon the interest is 52 per cent.

It is generally supposed that the best business is the power business. I remember in the early days when the rates were established to foster the power business of the Edison Electric Illuminating Company, of New York, the claim was made that you could afford to sell power at one-half the price if your current was going to be used for power when it was not going to be used for light. We have found that the power curve and the light curve cross each other for sixty days during the winter, and the claim which was made for the power business proved a fallacy.

In your lighting business—I am talking to people using large stations—you can get a class of business which will yield a bigger return on the investment from lighting customers than from power customers at a low rate, because the interest cost, if you have a 50 per cent. load factor, is only 25 per cent. of the total cost, whereas with power customers the interest is about 35 per cent. This chart properly studied should enable a man running the Chicago Edison Company to make a price list that would fit all kinds of customers. If we can do that in our business, surely you people can do it in your business. You will find, too, that the adoption of a system of rates that will take care of these different conditions will affect these items very materially. It will not affect lamp renewals, of course. It will certainly affect station repairs, general supervision, station labor, fuel and also general expenses. In other words it will affect by far the greater proportion of your expenses outside of interest charges, besides very materially affecting your interest charges, by putting your revenue on a basis so that it is in proportion to the interest you have to pay to take care of the customer whom you are supplying with current. You are putting your business on a basis so that you get a return on the investment which you have to provide for each separate customer. This subject came up for discussion last year at Niagara Falls. One gentleman, whom I am sorry is not here today, took the ground that we had to sell the product at the same price to everybody. If you do you are selling your product at different prices to every-

*Owing to the interesting character of the discussions and extraordinary length of the report the style of THE ELECTRICAL WORLD has been departed from in this instance and the matter set in smaller type.

body, because in one case you can make money and in another case you lose money. We do the largest office building business in the country, and I am perfectly willing to say to you that I do not believe we make any money, but I would not like to say it to the stockholders. If the expenses of a station are followed out in this way, you can get a great deal more out of the method by which you sell than you can out of the method by which you produce.

Mr. Barker—You spoke of the different classes of business earning a certain percentage on the investment. How do you apportion the investment among the different classes of business?

Mr. Insull—On our maximum output per year. We take an investment of that kind and divide the one by the other, and get the investment per unit at the maximum output. Then we get the maximum demand on us for current from the customer, and in that way we can figure his load factor. As we know what it costs for our investment per maximum unit of output, and as we know our customers' maximum demand——

Mr. Hubeley—How do you know that?

Mr. Insull—There are a number of ways of arriving at it. One is the use of a Bristol recording wattmeter, or you can use some kind of indicator that will show it. We use the Wright demand meter.

Mr. Wendell—How small a customer can you afford to take?

Mr. Insull—It depends upon the efficiency of the lamp. If you will give us a 25-watt lamp, we will take a customer whose demand is 25 watts.

Mr. Ferguson—We take every and any customer on the Wright demand meter basis, and we have a uniform schedule of prices for everybody, based on 1 cent per lamp per hour; that is the base rate. We charge the full rate of 1 cent per lamp per hour for one hour per day, as the maximum demand, and for all watt-hours beyond that hour we charge a half rate, 40 or 60 per cent. or anything you please. In regard to the question of what customers you can afford to take, that would involve a great deal of calculation. The simplest way is to charge a minimum bill to each customer, which will cover the smallest customer. If you charge a minimum bill for services furnished, that will cover interest and depreciation charges on the cost of the investment used.

Mr. Coggeshall—You charge one rate for one hour a day; and another rate for the rest of the day. How do you do it?

Mr. Insull—That is called the two-rate system. It is done by a meter with two dials, or a double meter.

Mr. Wagner—I understand from your remarks that the Chicago Edison Company is going to use the Wright demand system of charging, which is a very thorough way of providing for all these different classes of services. I should like to know if there is anyone else here who accomplishes nearly the same thing by any other method?

Mr. Dow—I have been into this thing up to my neck. I suppose that remark will interest a good many members here from small towns, say of 25,000 inhabitants. We have more than 25,000 people, but we have not money enough to buy Wright demand meters for all our customers just yet. We are going to do so some day. However, we use demand meters on a number of customers. We use them when there is doubt of arriving at the demand by any other means. We do not believe it necessary to leave them on continuously, but we put them on long enough to make certain that we have a fair average demand for the current twelve months, and in such cases we make the demand established by meter, and base a contract on it with the customer for the current twelve months. We say to them that they shall pay for that amount for twelve months, at the maximum rate, and everything beyond that at a minimum rate, and at the end of twelve months we will again meter in the same way, and reserve the right to put the meter on at any time to satisfy ourselves as to what the actual demand is. In some places we leave the meters on continuously. We would do so all the way through, but for the one point of not having money enough.

Mr. Ayer—I think it would be interesting to the members who did not attend the last convention when the Wright demand system was described to have a brief description of it given here by Mr. Dow.

Mr. Dow—The Wright demand meter is so far the most satisfactory method of recording the maximum that a customer takes at any time. The principle is the same as that which governs the registering thermometer. You know the style of thermometer, which not only shows the present temperature, but which at the highest point it reaches leaves a little globule of the colored alcohol, so that anyone on inspecting the thermometer can tell not merely the present temperature, as he can by looking at any other thermometer, but he can tell to what point the alcoholic column has risen since the thermometer was last set. The setting is accomplished by shaking down the retained globule, and the process of resetting in the Wright meter is the same. The meter has a fluid which is expanded by the heat generated by the electric current, and it leaves an indication showing that some time since you last set the meter the customer has used current to a certain extent, not that he has used so many watt hours, but that at one time for several minutes he called for so many amperes. That indicates, of course, the largest amount of machinery you have to install to take care of the customer.

Now to answer the question raised as to how anyone has reached the same result by other means. In arc lighting practically nine-tenths of the business is with customers whose lamps are all turned on at once. If a man has ten arc lights he is likely to use all at the same time, so that in the majority of cases the arc lamps will be an exact measure of the demand. With certain classes of motors the same thing applies, not with all classes by any means, because there is nothing that is more frequent than a motor running at a much less load than it is rated, or they seldom use continuously any length of time the maximum. The matter of elevator motors to which Mr. Scovil referred is in that line. There is a large amount of motor business where you can put on an ammeter and ascertain the largest demand. As we are situated now we have been trying to develop the motor business and inspect motors frequently, and we have not so many that a faithful man cannot visit them all in five weeks. We are not missing anything, but our method of checking depends on personal knowledge, and can only be looked upon a makeshift. It does not compare with the method of gauging the arc lights, but as a temporary device it fills the bill. Beyond that you have still another class of customers, small barber shops, saloons, cigar stores, new stands and fruit stands that use only a few lights and keep open long hours. They are good customers. Beyond that is the general use of incandescent lights, where some meter must be used. It limits the necessity of the application of the demand meters to one part of the business, and that may be one-half or one-third of the whole business. If there is any place in the world where a demand meter is a good thing it is in a residence. In the absence of the meter system in residences we have instituted a method of assessment according to the number of rooms in a house and the number of persons likely to use the light.

Mr. Ferguson—Mr. Dow made the statement that he could not afford to buy demand meters. He can do it after a while, but cannot afford to do it now. After listening to what he said I think he is much mistaken. I think he is spending too much of his valuable time in attempting to understand the personal characteristics of his customers. I am sure that if he does that properly, if he ascertains the characteristics of his customers so well that he can approach the work done by the Wright demand meter, he must employ a large force of assistants, and when we consider that the cost of demand meter is small in proportion to the total investment, and when we consider the immense amount of business that can be obtained by using the demand meters, I think he can well afford to buy them. We will suppose that in Chicago we have 5000 customers and the cost of the instruments would be something like $50,000 for all these customers. We do not spend all the entire sum in one year; it would take some time. Our business has improved largely by the use of the meter, and we cannot get instruments fast enough. We have made contracts on the Wright demand basis, and a month has passed and we have not the Wright meters in. If that is so, it seems to me that any central station man can well afford to borrow the money, even at a very high rate of interest, as Mr. Ayer has just suggested, and purchase the meters. The additional business that you will get by the use of such instruments will more than compensate in a few years for the total investment by having an instrument to measure the current properly. We have listened to papers in these conventions showing the economy to be effected in generation and distribution and that sort of thing. It seems to me there is more money to be made in the intelligent selling of your product than in attempting to introduce further economies in operation. With an instrument like the Wright demand meter you are put in a position where the instrument does for you what you will otherwise have to do by skilled labor at a very high cost. I say this from experience. For three years I have personally negotiated contracts for the Chicago Edison Company on a basis similar to that described by Mr. Dow. I have had customers come into the office and talked with them to ascertain the conditions under which they burned their light, and made prices, with 15 and 25 and up to 65 and 75 per cent. discount, depending on the conditions under which they used the light. Since we have put in the Wright demand system the work is lessened, I am able to give my attention to other things and let the meter do the work for me. There are other ways, of course, of getting at the information, and we have used them. We have used, for instance, the Bristol recording ammeter, which is useful for ascertaining the maximum load in any customer's premises. It is slow and can only be used in large installations, like hotels and theatres, where you desire to make a uniform discount for the entire year, which is practically the same as selling current on the Wright demand system. It is the load factor system; the only system based on load factor. If you know by the Bristol recording instrument that the load factor is 50 per cent., you can make the rate for the entire year at a uniform discount, which is the same as putting in the Wright demand instrument. It is tedious and much more expensive than buying the instruments and asking them to do the work for you.

In further reference to this question of dealing individually with customers, especially in residences, upon which Mr. Dow dwelt particularly, the load factor varies greatly and you cannot classify residences; it is almost impossible to do so. We have not made any increase since starting in with the Wright demand system. We have not published the fact that we are selling electric light on that basis as yet. We have, however, instructed our men to take all new business on that basis. We sell arc lamps at a flat price per week from dusk to midnight. With the exception of that and the power business it is all done on the Wright demand basis. We put our arc light and incandescent light on the same meter. The reading of the demand meter is made at the same time as the reading of the wattmeter. The wattmeter is placed on the wall and the demand meter under it. The latter is graduated in kilowatt hours, the same as the wattmeter.

Mr. Weeks—I would like to ask what has been the effect upon your revenue of the lower rates for summer service.

Mr. Insull—We do not know yet. We only put it in operation during the last few weeks.

Mr. Weeks—It seems to me that it is somewhat inequitable to make a lower rate for transient summer service, such as that of the customer who operates a fan but a few weeks or months at most in the year, while his rate on account of the interest factor should be higher rather than lower than that for most other classes of service.

Mr. Insull—We have a large by-product that we want to sell, which usually lies idle in the summer; and we endeavor to dispose of it to these casual users.

On motion the meeting adjourned until 3 o'clock.

AFTERNOON SESSION.

President Insull called the meeting to order at 3:10 P. M., and announced the first paper to be that of Mr. Alexander Dow, of Detroit, Mich., on "Public Lighting, with Relation to Public Ownership or Control." This paper will be found abstracted in another column.

In the discussion of this paper, Mr. Samuel Scovil, of Cleveland, thought that there would be a general agreement with the statement made by Mr. Dow that there is immediate need for clear thinking and for well-considered speech and action in reference to the attitude being assumed by the public toward those corporations performing so-called public services. As he understood it, the proposition made by Mr. Dow, if accepted by this association, might be stated in a resolution as follows: "Resolved, that we, the managers of private lighting companies, in convention assembled, deliberately declare that it is perfectly equitable that part of the capital which we have invested in good faith and with commendable enterprise be now confiscated by the municipality which we have been serving." He did not claim that a municipality should pay more for its public lighting than it could do the work for itself. What he did claim was that there was nothing in the history of municipally conducted industries, either at home or abroad, which would indicate that they can approach the privately conducted enterprises in economy of operation, if

the municipality will grant and secure to a private company the same privileges and security that it assumes for itself. In his opinion, preference should be given in every case by municipalities to a private company for municipal lighting at the same cost, as compared with a municipal plant. A contract made with a private company is a known expense. Municipal ownership and operation is an unknown expense.

Mr. H. M. Atkinson, of Atlanta, Ga., thought that the association should adopt a platform enunciating its principles on this question, which, by its conservatism, temperate tone, fairness and broadness, would appeal to the taxpayer and intelligent voter. It must stand fairly on the platform that we as taxpayers, as well as owners of electric light works, are opposed to the policy of municipal ownership and operation, as our experience has shown us what it is.

WEDNESDAY, JUNE 8, MORNING SESSION.

The meeting was called to order at 10:30 o'clock by President Insull. The first business was the reading of a paper by Herbert A. Wagner, of St. Louis, on "General Distribution from Central Stations by Alternating Currents." This was followed by a paper entitled "General Distribution from Central Stations by Direct Currents," by Louis A. Ferguson, of Chicago. Mr Wagner's paper is reprinted elsewhere in this issue. Mr. Ferguson's paper will be treated in a later issue.

Professor Fujioka, of Tokyo, Japan, opened the discussion on these papers, and gave a description of the plant and system which had been established in Tokyo under his direction.

In reply to a question Mr. Wagner stated that by making the transformer practically an integral part of the feeder, all the effects of transformer drop can be eliminated by regulating the pressure on the feeder, so that the regulation of the transformer to secure a very low iron loss can be sacrificed. He stated further that a poorly regulated transformer is very much better for use in a system where transformers are connected in multiple, provided the pressure of each transformer can be regulated independently. In the system described the highest efficiency is at the average load, so that if a transformer were cut out and its feeder were cut out it would decrease the average efficiency rather than raise it, as it would increase the load on the other feeders, and increase the copper losses in the other feeders and other transformers, and that increase in copper loss would be greater than the iron losses which it would sustain temporarily. It is highly desirable to design a system which shall be most efficient at the average load. With a transformer that can be accomplished successfully. In reply to other questions Mr. Wagner stated that the wattless current is inappreciable. The volt amperes and the watts correspond so nearly at full load that the difference is almost inappreciable even in the most poorly designed station. The power factor is very high at maximum loads, and with a system of this kind the power faction should be practically 100 per cent. at all times, except with alternating motors, which would lower it slightly.

Professor Goldsborough, in referring to sub-station transformers, thought that there was an opportunity to improve the low load efficiency of a plant. He noticed from the curve in Mr. Wagner's paper that the load falls off and down below the direct-current curve for loads less than 8 per cent. That loss must be due to the inefficiency of the transformer, because the only difference between the two systems is in the transformer, the copper being the same and the iron loss is the important factor. It seemed to him, however, that a system of sub-stations could be devised and a number of transformers placed together, and a set of feeders could run from the central station to the substation, so arranged that some of the transformers could be cut out, all of the feeders being used in circuit with the reduced number of transformers. In that arragement there will be less core losses, and consequently improved efficiency at the lower load.

Touching the subject of the use of single-phase alternating current, Professor Goldsborough stated that it had many advantages over the multiphase system in view of the better regulation.

Mr. Scovil wished to hear any opposite view to the statement made by Mr. Wagner in his paper that where lighting is a distinct feature, and first-class service is to be rendered in a large station, the three-phase system cannot be used successfully. Mr. Rice stated in reply that he had visited the stations at Salt Lake City and Sacramento, and that the designing engineers of both claimed efficiency and elasticity superior to the Edison three-wire system. They have the three-phase, four-wire distribution system in the Salt Lake plant, about 15 miles, and at Sacramento, it is nearly 20 miles. It seemed to him that the feature is brought out that the two systems are being compared, one of which is brought to a high state of development, and one of which is just beginning to be developed. He thought that Mr. Ferguson's example of the alternating plant was very unfortunate, in that it does not represent an alternating plant of the very latest design. It is now past discussion that alternators may be thrown in parallel the same as continuous-current generators. The use of motors is another feature which is coming into prominence. The alternating-current motors have not been developed and applied the same as continuous-current motors, simply because they have not lived long enough. The same idea applies to the alternating-arc lamp.

Mr. Pillsbury stated that single-phase alternating-current motors are now made equal if not superior to direct-current motors for general power distribution. The power factor in a well-designed machine may be considerably above 90 per cent., with loads from 50 to 150 per cent. of its rated capacity, and above 80 per cent., while the motor is developing 20 per cent. of its rated capacity. For general power distribution these are superior to direct-current motors in point of care and attendance required, average efficiency, absence of wear, etc. The only problem met in their application to direct driving of elevators is that of starting. There are two methods of doing this; one by splitting the phase and another by introducing a commutator. Either of these is entirely successful.

Mr. Insull stated that within the last week his company had shut down a three-wire system. He would like within the next week to shut down an alternating system. With his company it is simply a question of the most money it can possible make out of a given investment. He thought that a study of Mr. Ferguson's paper would show that the author had gone into the question not merely from the theoretical point of view, but that his observations are based upon the actual results obtained in a year's operation of a large property. A study of Mr. Wagner's paper would show that he presented a new scheme that has not stood the test of time, and that cannot be said to be in comparison with the low-tension system until a company under Mr. Wagner's plan has developed its business to a point where you can make a comparison of investment with investment, expenses with expenses and return with return.

Mr. Ayer stated that one thing was generally understood by the operator of central stations in the last few years, and that was the necessity of getting rid of the house-to-house transformer, which means going to the three-wire distribution. We are all working to that end, he said.

The meeting then adjourned until 3 P. M.

The afternoon session was occupied largely by the discussion of Mr. Ferguson's paper.

Mr. Walbank stated that he disagreed with one point in Mr. Wagner's paper where it was stated that the three-phase system was not adaptable to lighting houses. He stated that his company was installing a three-phase plant of considerable size. It has been in operation for six or eight months. Before that the company had a single-phase plant of between 4000 and 5000 lights. The present installation is 30,000 lights on the three-phase system. Light and power are run, and there is no difficulty in regulation. There is no regulator on the circuit. The regulation is from rheostats. The company intends to put in the induction regulator.

I think the statements that were made in regard to the amount of copper required are somewhat misleading. When you consider the cost of copper in the alternating current system, together with the transformers of such systems as have been compared to it, the difference is slight in comparison to the total investment. I would also point out the fact that the cost of copper, which has been made such a strong point of, is really not so important after all, because the value of the copper is only about 20 per cent. of the underground equipment, so that even if you did make a material saving in copper, the total percentage on the total investment would be much less.

Mr. Wagner stated that the figures given for feeder drop in the curves were intended to approximate the conditions existing here in Chicago, and as Mr. Ferguson has shown, the efficiency that I gave was higher than he actually finds. Considered from the most economical standpoint, the cost of conductors, the cost of real estate and the advantages of location, usually some distance from the centre of distribution, where facilities can be found for condensing and for getting coal cheaply; these are considerations which must be taken into account, and while it is possible to reduce the distribution losses, as I said, to any extent, it is not as a rule economical to do so, as it necessitates a location which is not in itself economical for station operation.

Mr. Dow asked about the additional resistance in the mains where alternating current is used. All the tables which have been used show this increase in resistance, and they have only taken into account the cables themselves, and not the load on the circuit in connection with the cable loss or the power factor of the load. Were those taken into consideration, and the conductors placed together as near as possible and under one lead sheath, on conductors as large as 300,000 circular mils, which are as large as are generally used for distributing mains, the difference between the alternating current and the direct current is inappreciable. With numerous tests on that size conductor, I have found that the difference in drop with a given current, with a power factor of 100 per cent., is about 10 per cent. The actual drop is increased 1 per cent. with the alternating current. With a power factor as low as 75 per cent., which is as low as any combination of power and light would be on such a system, it is increased to 3 per cent. additional. The 2 per cent. drop of the direct current would be increased to 2.3 per cent. The additional cost for alternating mains, three-wire system, would be practically nothing. The figures I gave on the efficiency of alternating enclosed arc lamps, in comparison with the watts consumed for a given amount of light with the alternating and direct current, are correct. They are made from actual experiment, and I can also say that the alternating current enclosed arcs which we have in use are every bit as satisfactory as any direct current enclosed arc that I have seen. We have about 100 in use commercially. In two months we have changed two lamps out of that hundred. The light is fully as good as the direct current. It is not the standard alternating enclosed arc. It is made specially for a large amount of current, and takes seven and one-half amperes and 110 volts, or 550 watts in circuit. In addition to these lamps we have 3500 alternating arcs for street lighting and commercial lighting, and they are giving satisfaction. The open alternating arcs for commercial use are operated in connection with armatures specially designed to give smooth waves of current, and there is less noise than in any place I have seen arc lamps in operation. The matter was carefully considered in the designing of the generators. The enclosed alternating arcs are practically noiseless; we might have three in this room, and no one would notice the noise, with sixty cycles and the special form of armature referred to.

Mr. Dow also spoke of the increasing use of electric elevators, with motors directly connected to the drum mechanism. I said in my paper that this is the only service that we are not able to render with alternating current motors. I have, however, since preparing the paper, in the last few days heard of one installation of six or eight elevators using two-phase alternating current motors, which were controlled from the elevator in about the same way as direct current elevators, and directly connected to the driving mechanism, and were in satisfactory operation. It is well known that alternating motors can be regulated and the torque increased at slow speeds by means of suitable resistances. It seems only a question of a short time when this work will be acomplished satisfactorily by alternating two-phase current motors. Single phase motors have not been tried for that, but a single-phase motor can be controlled in speed in exactly the same way, with a few modifications, that a three-phase motor can be controlled, and I have no doubt that before a year is past single-phase motors up to 25 horse-power, which is as large as necessary to run elevators, will be used for that purpose

Professor Goldsborough spoke of the use of sub-stations and cutting off the transformers at times of light load. That could be done in the small stations, but in a system where the distribution efficiency is already slightly over 96 per cent. on the average load, and that is all we have considered, it would seem inadvisable to go to any expense to provide sub-stations or devices for cutting in and cutting out transformers at sub-stations to increase the efficiency.

Mr. Wagner replied to other questions brought up during the discussion, after which the meeting adjourned until Thursday morning.

On Wednesday evening Mr. Joseph Wetzler delivered a lecture on "Electricity Direct from Coal," illustrated with stereopticon views. The lecture was well attended.

MORNING SESSION—THURSDAY, JUNE 9.

The first paper read was on the "Cost of Producing Electric Power by Water Power from Lachine Rapids," by Mr. W. McLea Walbank, of Montreal. An abstract of this paper will be found in another column.

In the discussion Mr. Walbank, in reply to a question, stated that the cost given in his paper is based upon the possible output of a plant independent of the number of hours that it is used.

Mr. Ferguson—To compare a water-power plant as described by Mr. Walbank with a steam plant, I would like to offer as a permanent installation one equal to that outlined by Mr. Walbank, our system in Chicago represented by the Harrison Street station, and I think all who have seen that plant will agree that that station is quite as permanent from the standpoint of investment as the system outlined by Mr. Walbank. To show the comparative cost of producing a kilowatt hour I would like to offer some figures. The cost of the station, including the transmission line, is $1,200,000; the interest on that amount will be $72,000; total cost of operating at the switchboard of that station is $77,000 per year; the two latter items added together make $149,000. Taking the same percentage for depreciation that Mr. Walbank does, we have a depreciation of $20,000, making the total operating cost $169,000. The total maximum capacity of that station is 7000 kilowatts, so that the cost per kilowatt in that station would be $24, as compared with $22.90, stated by Mr. Walbank; thus the difference between the cost of generation of a water-power plant and that of a first-class steam plant is very slight.

Mr. Walbank—What price do you pay for coal?

Mr. Ferguson—$1.12 a ton.

Mr. Walbank—We pay $3.50 a ton.

Mr. Ferguson—I think in these figures Mr. Walbank has left out an important thing. We ought to know what the load factor of the system is, because the figure of $10,000 is proportional with his output, or it will vary with the output, so that the load factor is now only 10 per cent. It is hardly fair to compare the cost he has presented with a system having a load factor of 25 per cent. I took a station of 25 per cent. If it was only 10 per cent., then, of course, the output per kilowatt capacity would be less, and the figures would be still more favorable to the steam plant.

Prof. W. E. Goldborough then read a paper on "Transformer Economy," which was exhaustively discussed.

At the afternoon session the committee on standard candle-power of incandescent lamps, of which Dr. Louis Bell is chairman, made its report. The report is as follows:

Your committee has been able to have tested in the most careful manner through the courtesy of Prof. W. L. Puffer, of Boston, 16-cp incandescent lamps from eleven different makers. The lamps were obtained directly from the makers or their authorized agents, and were known to be for test.

These lamps were all sold for 16-cp, 110-volt, no watts specified, and may be fairly assumed to represent the product which would be shipped to consumers who did not desire the lamps for test, although one batch of lamps came with the bases marked to show the point to be turned toward the photometer screen.

On test these lamps, thirty-three in all, averaged 14.1 mean normal candle-power and about 11.7 mean spherical candle-power. Only one batch of three averaged over 16 normal candle-power. One batch fell below 11 normal candle-power and two below 12 normal candle-power. Five makers fell below 14.5 normal candle-power. The highest average of any batch was 16.99, the lowest 10.82. The average consumption of energy was almost exactly 4 watts, the lowest 3.78 watts per candle, and two batches ran over 5 watts. It should be noted that the voltage was determined by a Weston voltmeter freshly compared with Clark cells, and each lamp was run at its marked voltage (110).

A separate series of tests showed that these lamps on the average gave their greatest mean candle-power when measured under rotation with their axes tilted 44 degrees and 24 minutes from the vertical toward the photometer, thus confirming closely your committee's estimate of 45 degrees as a proper angle. A series of tests on proper speed of rotation showed that the best results were obtained with a speed of 200 to 250 r. p. m., and that the lamps would readily stand this speed.

Many of the lamps showed bad spherical distribution, which seems to be quite needless, since it is merely a matter of proper proportioning the form of the filament.

Of an equal number of batches of 32-cp lamps, only one batch averaged 32 normal candle-power, the majority falling to from 26 to 28 candle-power. The 32-cp lamps averaged slightly greater efficiency, but were otherwise much like the 16-cp size.

From this investigation the fact stands out that the incandescent lamp sold for 16 candle-power is, on the whole, a lamp which is often giving considerably less than its rated candle-power even when new. Some of these lamps would probably show a temporary increase of candle-power after, say, fifty hours' burning, but the committee has not extended the research in this direction as yet, and adheres to the opinion that the initial candle-power is the only practicable commercial test, and any increase consequently is simply to be regarded as a device for keeping the lamp a little longer from its inevitable decay.

From these and other data kindly furnished by manufacturers and obtained from various other reliable sources your committee is convinced that the need of a uniform rating is even greater than is concluded in the preliminary report of last year, and that a rating test, in order to be effective, must involve measurement of candle-power of lamps in more than one direction. Neither mean horizontal, nor mean spherical candle-power, nor candle-power in any one direction will define a lamp well enough to warrant adherence to the rating. Your committee therefore recommends that incandescent lamps be required to conform both to a standard mean normal candle-power and to a mean candle-power when revolved with the axis tipped 45 degrees, this representing the spherical distribution. It recommends that the limits for the mean normal candle-power be 15 and 17.5 candle-power. Unless the minimum be as high as 15 there will certainly be found a tendency to produce lamps near the lower limit. The 45 degrees candle-power should be at least 85 per cent. of this minimum. This is not an excessive requirement, and will tend to prevent working near the lower limit of horizontal candle-power, unless with a lamp very good in other respects.

Your committee has blocked out a standard form of photometer, a type of which it proposes to build, test and put at the disposal of the association with directions for proper use.

It suggests that testing be by sample, a lot of ten lamps being taken from each barrel. Of these no lamp when run at its marked voltage shall show less than 15 or more than 17.5 candle-power, mean horizontal, when rotated at 200 to 250 r. p. m.; and no lamp shall give when thus rotated at 45 degrees inclination less than 85 per cent. of the above minimum.

The committee will make arrangements for standard lamps as indicated in the preliminary reports to go with the standard photometers.

The report was adopted and the president appointed Messrs. James I. Ayer, Louis A. Ferguson and Calvin W. Rice a committee to continue the work.

The Committee on Amendments to Freight Classification asked for more time, and its report was postponed until next meeting.

The meeting then went into executive session. It was resolved to hold the annual meeting in May or June each year, alternately in the cities of New York and Chicago, unless otherwise directed by the executive, and on such date as the committee shall determine.

Votes of thanks were tendered to President Insull for his untiring efforts to make the convention a success, to the Chicago Edison Company, the Metropolitan West Side Elevated Road, the South Side Elevated Road, the Northern Steamship Company, the Chicago & Long Distance Telephone Company and others for courtesies.

The election of officers for the ensuing year resulted as follows:

President A. M. Young, Waterbury, Conn.; first vice-president, E. W. Rollins, Denver, Col.; second vice-president, F. A. Gilbert, Boston, Mass.; members of the executive committee, Samuel Insull, Chicago, Ill.; Samuel Scovil, Cleveland, Ohio; H. M. Atkinson, Atlanta, Ga.; F. A. Copeland, La Crosse, Wis. The convention then adjourned sine die.

Convention Notes.

THE CRAVATH MANUFACTURING COMPANY had its interests taken care of by the president, Mr. J. R. Cravath.

THE NEW YORK & OHIO COMPANY, Warren, Ohio, was represented by Mr. W. D. Packard, of "Packard" lamp fame.

THE INDIANA RUBBER & INSULATED WIRE COMPANY, of Jonesboro, Ind., was represented by Mr. R. E. Lucas.

THE SIMPLEX ELECTRICAL COMPANY, Boston, Mass., was represented by Mr. H. R. Hixson, of the Chicago office.

THE H. B. CAMP COMPANY, Aultman, Ohio, manufacturer of vitrified clay conduit, was represented by Mr. A. L. Daniels.

THE ZAMEL ARC LIGHT METER COMPANY, of Chicago, was represented by Mr. A. G. Zamel and Mr. Charles C. Schumacher.

THE BRADFORD BELTING COMPANY, of Cincinnati, Ohio, had its "Rivetless Monarch" belts described by Mr. O. M. Hubbard.

THE MUNSON BELTING COMPANY, Chicago, was thoroughly taken care of by the most popular salesman of the age, Col. J. H. Shay.

THE DAVIS ELECTRICAL WORKS, of Springfield, Mass., was well represented by Mr. Charles F. Munder, treasurer and manager of the company.

THE WASHBURN-MOEN MANUFACTURING COMPANY, Worcester, Mass., had its wires talked about by Mr. Channing T. Gage, of the St. Paul office.

GALES COMMUTATOR COMPOUND, manufactured by K. McLennan & Co., of Chicago, was brought into prominence by circulars that could be found everywhere.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., was represented by Mr. A. C. Garrison and its Chicago representative, Mr. J. C. Rex.

MR. CYRUS O. BAKER, JR., master of transportation, was elected an honorary member of the National Electric Light Association at the Chicago Convention.

THE CHARLES E. GREGORY COMPANY'S Western Bargain House was strongly represented by its hustling manager, Mr. A. Louis Kuehmsted and Mr. Raymond.

OKONITE insulation does not need any convention representation, but Capt. Willard L. Candee and Mr. George T. Manson talked insulation to high tension people.

MR. THOMAS S. GORDON, of Chicago, buttonholed the delegates and interested them in his extensive line of bare and insulated copper wire, rail bonds, iron wire, etc.

MR. T. JULIEN McGILL, who represented the Westinghouse Company, has recently resigned his position as general sales agent for the Siemens-Halske Electric Company.

THE LAKON COMPANY, Elkhart, Ind., was represented by Mr. J. C. Boss, president of the company and one of the men central station managers like to meet and talk to.

THE MILLER-KNOBLOCK COMPANY, of South Bend, Ind., did not need to exhibit, as its goods were explained and described with sufficient enthusiasm by Mr. A. W. Morrell.

I-T-E CIRCUIT BREAKERS were called to mind by the sight of Mr. H. B. Cutter, who was always interested and talking about the complete motor control features of his breaker.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Chicago, had its latest designs of rheostats, motor controllers, circuit breakers, etc., described to the delegates by Mr. Harry H. Cutler.

MESSRS. CHARLES A. SCHIEREN & CO., New York, distributed various

circulars at the convention, one of them being a list of big belts. Mr. A. W. Watriss looked after the interests of the company.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, Hartford, Conn., was ably represented by its president, Mr. C. G. Perkins, and its Chicago representative, Mr. Edward K. Patton.

THE WARREN ELECTRIC & SPECIALTY COMPANY, of Warren, Ohio, was talked about by Mr. W. S. Hull, the Chicago agent, as well as by Mr. E. W. Gillmer, secretary and general manager of the company.

MR. C. O. BAKER, JR., was of course prominent in this as in all other conventions and exhibitions. Mr. Baker acted as master of transportation, and chaperoned the New York delegation with the skill born of long experience.

THE CABINET MANUFACTURING COMPANY, of Steubenville, Ohio, although its main work is in the telephone line, is sufficiently interested in electric lighting work to send its representative, Mr. J. W. Hull, to the convention.

THE ROYAL ELECTRIC COMPANY, of Peoria, Ill., was ably represented by Mr. G. G. Luthy, who was full of the interesting subject of the alternating and direct current dynamos, motors, transformers, etc., manufactured by his company.

THE INDIA RUBBER & GUTTA PERCHA INSULATING COMPANY, New York, was represented by Dr. William M. Habirshaw, whose name, as it is synonymous with the insulation so widely used, is better known than that of the company.

THE AMERICAN CIRCULAR LOOM COMPANY, of Boston, Mass., was represented by Mr. H. H. Brooks, who distributed to his many friends a useful souvenir in the shape of a box containing a handsome pipe, with tobacco and matches included.

THE AMERICAN BATTERY COMPANY, Chicago, was well and ably represented by Mr. George T. Borroughs, who invited the delegates to call upon the company and find out the good qualities of its storage batteries for fan and other purposes.

THE AMERICAN ELECTRIC HEATING CORPORATION, of Boston, Mass., was represented by Mr. James I. Ayer, who, as an ex-central station man, has not lost his interest in the questions of municipal ownership and alternating vs. direct currents.

THE STANDARD UNDERGROUND CABLE COMPANY, of Chicago, distributed a device similar to a whist counter, which served as a reminder that Standard underground cables are as reliable as Ohm's Law. Mr. J. R. Wiley represented this company.

THE CENTRAL MANUFACTURING COMPANY, of Chattanooga, Tenn., could have had no better representative than its president and manager, Mr. W. B. Hughes, who talked about the yellow pine cross arms, oak brackets and electrital mouldings made by this company.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, Indianapolis, Ind., was well looked after by Mr. C. D. Jenney. Few gentlemen in the electrical business claim more friends than Mr. Jenney, and they saw to it that he did not regret coming to the convention.

THE ELECTRIC APPLIANCE COMPANY, Chicago, although it needed no introduction to the electrical fraternity, had its interests looked after by W. W. Low, president, and his assistants, Messrs. B. B. Downs, C. J. Wells, W. M. Brooke, Charles B. Obermeyer and H. L. J. Towner.

THE AMERICAN CARBON COMPANY, of Noblesville, Ind., was represented by its general manager, Mr. Edmund Dickey, and his assistants, Messrs. A. T. Webb and A. J. Blum. Mr. Dickey was very active from start to finish. There were few men more popular with the delegates.

THE WESTERN KIELEY STEAM SPECIALTY COMPANY, of Chicago, showed in the hotel lobby an automatic damper regulator. Mr. C. F. Mitchell explained to those interested the steam traps, pressure reducing valve, back pressure valves and other specialties made by the company.

THE INTERESTS of the Siemens-Halske Electric Company, of Chicago, was looked after by Mr. R. D. Allen, general sales agent, and Mr. W. L. Arnold, district sales agent. If Mr. Allen missed any contracts that were obtainable from the delegates at the convention it was not his fault.

THE JANDUS ELECTRIC COMPANY, Cleveland, Ohio, made itself known to the attendants through Mr. H. T. Edgar, the New England manager. On account of the present rage for enclosed arc and the popularity of the Jandus lamps, Mr. Edgar found no difficulty in securing a hearing.

THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., makes switches, and if anybody did not hear about them at the convention it was certainly not the fault of its well-known and popular Western manager, Mr. Edward R. Grier, who talked Bryant switches from morning till night.

THE SOUTHWARK FOUNDRY & MACHINE COMPANY, of Philadelphia, has as its Chicago representative Mr. Edward M. Hagar. The engines manufactured by this company are now exclusively used by the Chicago Edison Company, a fact which Mr. Hagar did not fail to let everybody know.

THE D. & W. FUSE COMPANY, Providence, R. I., showed in the main parlor of the hotel a number of its fuses mounted with various auxiliaries, such as switches, lightning arresters, etc. The advantages of the enclosed fuse with an air cell were discussed by Mr. L. W. Downes and Mr. A. W. Hutchins.

THE BRYAN-MARSH COMPANY was represented by Mr. Converse D. Marsh, who talked about lamps; Mr. S. Everett Doane, who talked about carbon chemistry, and Mr. J. M. Hill, who, when he was not working for the Northwestern excursion, found time to speak a good word for the Imperial lamp.

KERITE WIRES AND CABLES were of course represented by Mr. George F. Porter, secretary of the association. Mr. Porter's official duties were sufficient to prevent his working for Kerite, but his business connection is so widely known that his very presence spoke for Kerite. Mr. E. L. Barr also represented Mr. W. R. Brixey.

THE FOSTORIA INCANDESCENT LAMP COMPANY, of Fostoria, Ohio, was brought to the notice of the delegates by very pretty blotters, showing entwined American and Cuban flags and fancy designs of the Fostoria lamps, which were scattered throughout the hotel. Mr. J. B. Crouse saw to it that everybody should know about these lamps.

THE ILLINOIS ELECTRIC COMPANY, of Chicago, had its interests looked after by Mr. H. E. Adams. During the convention other officers of this company put in an appearance, namely, Mr. Frank E. Healy, Mr. Lemuel K. Cushing and Mr. Carl Keith. These gentlemen are doing a nice business, and their many friends wish them every success.

EUGENE MUNSELL & CO. and the Mica Insulator Company, of New York and Chicago, were represented by Mr. Chas. E. Coleman, manager of the two concerns in the West. The companies' blotters were distributed freely at the writing rooms and various headquarters of the different companies represented at the Auditorium during the convention.

THE STANDARD FIRE PROOFING COMPANY, of Perth Amboy, N. J., was well represented by the manager of its electric conduit department, Mr. C. J. Field. Mr. Field explained the advantages of this company's vitrified conduit with its self-aligning socket joints, which require no great care in the laying or perfection in the concreting to maintain them in alignment.

MR. A. O. SCHOONMAKER, of New York, through his Chicago representative, John Child, made a rather striking exhibit in the form of a sheet of clear, transparent mica hung over the main stairway in such a way that the delegates could not help seeing through it on their way downstairs. Over the sheet, which was 12x24 inches in size, hung the sign "Will this cut your segment?"

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, was represented by its president, Mr. P. C. Burns, who casually called in to meet his many old-time friends with whom he was closely associated before entering the telephone field. Mr. Burns, as everyone knows, has not only made a great financial success of the telephone business, but has also built up a reputation for first-class work throughout the country.

THE DEARBORN DRUG & CHEMICAL COMPANY, of Chicago, was represented by Mr. Charles S. Kehler, of the Milwaukee office, who explained to the central station men the value of the Dearborn boiler compound and the advisability of boiler users sending to the company's laboratories for analysis a sample of the feed water used. Mr. Kehler also did not forget to explain the good qualities of his company's lubricating oils.

THE SPRAGUE ELECTRIC COMPANY, of New York City, occupied two of the hotel parlors. Its column and desk Lundell fans occupied many other parts of the hotel. One summer and winter fan was on the main desk, but the winter feature was not found necessary. The company's interests were looked after by Mr. E. H. Johnson, vice-president and general manager, and Mr. Charles A. Benton, general sales agent. Mr. M. B. Kitt and E. B. Kittle, of the Chicago office, assisted.

THE PHŒNIX CARBON MANUFACTURING COMPANY, of St. Louis, Mo., makes a specialty of carbons for telephones, microphones, batteries, lightning arresters, etc., but still does enough work in the electric lighting field to make it well worth for the general manager, Col. S. G. Booker, to be present at the convention. The specialty of the company's work, namely, the porous battery carbon, removable from the more solid carbon cap by a screw joint, is used in 30,000 batteries contracted for in one order by Mr. P. C. Burns, of the American Electric Telephone Company.

THE DIAMOND ELECTRIC COMPANY, of Peoria, Ill., showed two of its new alternating current integrating wattmeters. The newest form of this instrument differs somewhat from all previous types. One aluminum disc is driven by the current induced in it by an A. C. magnet, embracing it on one side, and is retarded by a permanent magnet embracing it on the other side. The case, instead of being lowered onto the meter, is fitted on a round socket joint embracing the back of the meter, and rendered dust and bug proof by a rubber gasket.

THE WALKER COMPANY, of Cleveland, Ohio, was represented at the convention by J. Holt Gates, Geo. B. Foster, C. H. Philbrook and F. H. Talbot, of the Chicago office. Many of the delegates were interested in the new alternating system of the Walker Company, as well as its new solenoid blow-out controller; also the "L" type of street railway motor of 150 horse-power, twenty of which are being supplied the Metropolitan Elevated Railroad of Chicago. Many of the visitors called at the new station of the Chicago City Railway, which is designed for fifteen 880-kw Walker rope-driven generators.

THE ROCKWOOD MANUFACTURING COMPANY, of Indianapolis, Ind., displayed in the main corridor an ingenious testing machine for showing the relative adhesive co-efficients of leather belts on compressed paper pulleys and iron-faced pulleys. One end of the belt was held taut by a weight and the other was attached to a spring balance, the pulley being turned by hand. The spring balance was hardly necessary, as it was difficult to twist the handle tight enough to slip the belt on the paper pulley, while it slipped with ease on the iron one. Mr. G. O. Rockwood invited the delegates to step up and turn the handle.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, was represented by Mr. Herbert Lloyd, the vice-president and general manager of the company. With him were Mr. John R. Williams, general agent for the company; Mr. Joseph Appleton, chief engineer of the construction department; Mr. Frank H. Clark and Mr. R. B. Daggett, respectively manager and chief engineer of the Chicago office. The company had its headquarters in one of the parlors of the hotel, where its representatives organized parties to visit the mammoth storage battery of the Chicago Edison Company, described in the last issue of THE ELECTRICAL WORLD.

THE WESTERN ELECTRIC COMPANY occupied one of the club rooms. Mr. L. K. Comstock, the superintendent of construction, had charge of the quarters, and was assisted by Col. George L. Beetle, Messrs. A. L. Tucker, T. G. Grier, C. D. Wilkinson, S. S. Jackson, H. E. Hering and others. The quarters were decorated with photographs of Western Electric apparatus and a full line of bulletins was distributed. A showcase of the Sunbeam incandescent lamps and a number of inclosed arcs and Western Electric Company fans were on show. Small parties of delegates were organized to visit the Chicago works of the Western Electric Company.

CIRCULARS, bulletins, catalogues, cards, etc., were distributed at the con-

vention by the following firms: L. A. Chase & Co., of Boston, manufacturers of the Elden direct and alternating circuit breakers; the Charles E. Gregory Company, of Chicago, who sent around a bargain sheet of dynamos, motors, transformers, instruments and accessories; the Mica Insulator Company, which distributed blotters describing "Perfect Micanite Insulator"; the Raster Carbon Rheostat Company, Chicago, issued a circular describing carbon rheostats for all purposes, and the M. C. Bullock Manufacturing Company, of Chicago, whose circular described and pictured its central valve engine of the Willans type for direct coupling to dynamos.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, of New York, sent to the convention two of its latest models of enclosed arc lamps. One of these, designed for alternating current work, is just out. The lamps embody many ingenious novelties. The control is effected by a ball clutch. The current is fed to the upper carbon through copper-plated steel balls, which make contact with a magnetized fixed piece, and the lamp is opened for trimming by lowering the inner globe through the bottom opening of the outer globe. These lamps are described and illustrated elsewhere in this issue. Mr. S. Marsh Young, vice-president and general manager of the company, explained the new lamps to the delegates.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, with headquarters at 104 and 106 Auditorium, was represented by F. H. Taylor, general sales manager; Arthur Warren, and A. S. Morris, of Pittsburg, and by Maurice Coster, Chicago sales manager; Henry Floy, W. S. Rugg, C. W. Regester, and T. J. McGill, of Chicago. The company's headquarters were tastefully decorated in the National and Cuban colors. They also exhibited a few well-selected pictures, showing the details of their various manufactures, and views of their shops. A neat effect was exhibited in the form of a shield with the company's motto, "The name Westinghouse is a guarantee," engraved thereon. The Sawyer-Man Electric Company had an interesting exhibit of incandescent lamps at the headquarters, and was capably represented by Messrs. P. H. Smith, manager, of Pittsburg, and C. A. Ross, of Chicago.

MR. J. F. CUMMINGS took care of the interests of the Cummings Electric Tube Company, the Cummings Conduit Company and the Armorite Interior Conduit Company. Mr. Cummings showed the newest thing in the underground cable line in the form of a cable insulated with wood. The sample which Mr. Cummings carried in his pocket contained a 0000 solid copper conductor, surrounded by a basswood dielectric about three-quarters of an inch in thickness in a steel shell or pipe. Mr. Cummings stated that this had withstood a breakdown test of 24,000 volts. The wood, after thorough kiln drying and a treatment with paraffine, is put onto the conductor in the shape of longitudinally split sleeves, the two halves of the sleeve being tongued and grooved to each other. One sleeve is placed over the other in such a way that the splits break joint with each other. The conduit is made up in 20-foot lengths. Mr. Cummings states that it is now ready for the market, and will be pushed as was Armorite in its pioneer days.

THE GENERAL ELECTRIC COMPANY was represented at the convention by the entire selling staff of its Chicago office and several representatives from its other sales offices. It made no exhibit, but parties of delegates were made up for the purpose of visiting the different great stations in Chicago equipped with the latest types of General Electric apparatus. By kindness of President Insull, of the Chicago Edison Company, and Mr. W. E. Baker, of the Metropolitan West Side Elevated Railroad Company, the stations of their companies were thrown open to these parties. A large delegation also accepted Mr. B. E. Sunny's invitation to visit the large storehouse and repair shop which the General Electric Company has established in Chicago. The General Electric Company made its headquarters at the Auditorium Hotel in Room 140, which was tastefully decorated with palms and ferns. A supply of illustrated literature was also provided for those interested. The interests of the company were cared for by a large corps of representatives from various cities.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., was well represented. Mr. H. A. Wagner was of course present and prominent, although nominally representing the Missouri Edison Company. Looking after the interests of the company in its quarters at the hotel were Mr. E. H. Abadie, manager of the sales department; Mr. W. A. Layman, assistant manager, and Messrs. E. S. Pillsbury and S. E. Johannesen, of the engineering department. The company showed a switchboard panel equipped with its illuminated dial voltmeter, ammeter and wattmeter, with series transformers for the same. The newest thing explained by the officers present was the new arc plug-board, a sixty circuit sample of which is now being installed for the Memphis Light & Power Company. This board has no cables, and is made up of four marble boards, one immediately behind another. A straight plug pushed through the blank hole in the front board engages in an ingenious phosphor-bronze receptacle buried in the second panel, and a similar receptacle in the third or fourth panel, according to the length of the plug. A large area of contact is assured in the receptacles by a helical spring wound tightly about them. This compact construction allows the sixty-circuit board mentioned above to be placed in a space just 20 feet long.

AMONG OTHER HOUSES represented at the convention are the following: Chicago Sectional Underground Electric Company, by C. H. Wilmerding; Stanley Electric Manufacturing Company, by William S. Hine; Walker Company, Cleveland, Ohio, by George B. Foster; Leschen-Macomber-Whyte Company, Chicago, by George S. Whyte; Eddy Electric Manufacturing Company, Windsor, Conn., by M. E. Baird; American Electrical Works, Providence, R. I., by F. N. Phillips; Weston Electrical Instrument Company, Newark, N. J., by Charles D. Shain; Meysenburg & Badt, Chicago, Ill., by R. F. Schuchardt; Sargent & Lundy, Chicago, Ill., by W. E. Pimlett; Chicago Insulated Wire Company, by William M. Smith; Anchor Electric Company, Boston, Mass., by Mr. N. Marshall; the Buckeye Electric Company, Cleveland, Ohio, by J. H. Cooke; Cosmopolitan Electric Company, Chicago, Ill., by Jacob Frank; J. M. Atkinson & Co., Chicago, Ill., by Mr. J. M. Atkinson; the Washington Carbon Company, Pittsburg, Pa., by Mr. J. S. Crider; the Standard Paint Company, by Mr. J. C. Shainwald; the Chicago General Fixture Company, Chicago, Ill., by Mr. W. F. Hold; the Bullock Manufacturing Company, Chicago, Ill., by Mr. John Svenson; Mr. George Cutter, Chicago, Ill.; Smith-Hill Elevator Company, Quincy, Ill., by Mr. C. G. Comstock, Mr. Thomas Holl and Mr. H. S. Wells; the T.-H. Carbon Company, of Boston, Mass., by Mr. D. F. Urquhardt; Dick, Kerr & Co., Toronto, Canada, by Mr. F. C. Armstrong; the Fort Wayne Lamp Company, of Cleveland, by Mr. L. H. Rogers; Partrick, Carter & Wilkins, Philadelphia, Pa., by E. Ward Wilkins; the Warren Electric & Specialty Company, Warren, Ohio, by Mr. E. W. Gillmer; the Solar Carbon & Manufacturing Company, Pittsburg, Pa., by H. E. Webb; the Atlas Engine Works, Chicago, Ill., by A. M. Morse, and the New York Insulated Wire Company, New York, by Mr. James Wolff.

Oscillatory Currents and Some of Their Phenomena; Supplementary.

BY PROF. E. F. NORTHRUP.

Experiments carried on after the matter on oscillatory currents* was written revealed the fact that, contrary to what was stated, micanite condensers are not as good as glass condensers made as described. There is no perceptible heating of the glass condensers, while the micanite condensers, especially if constructed of thin sheets of micanite, heat badly. It was also found that micanite does not serve as well as was supposed for the cylinders of the high frequency transformer. Thin layers of air get entrapped between the layers of mica where the oil cannot penetrate and a break-down, by the discharge short-circuiting along the micanite cylinder, is apt to occur. This difficulty is entirely avoided by constructing the cylinders of thin, red fibre sheet. The high potential transformer was designed for 125 *cycles* instead of 125 *alternations*, as stated.

Mineral Production of the United States During 1897.

The advance sheet of the mineral production of the United States in 1897, compiled for "The Mineral Industry" by Richard P. Rothwell, shows the production of aluminum last year to have been 4,000,000 pounds, valued at $1,400,000, against 1,300,000 pounds, valued at $520,000, in the previous year. The increase was due partly to the reduction in price for the metal and partly to the development of a greatly increased export trade. The increase in the production of copper from 479,806,183 pounds in 1896 to 510,190,719 pounds in 1897 came chiefly from the mines of Arizona and Montana. The production of carborundum increased from 595 short tons ($365,612) to 621 short tons ($153,812). The decrease in value was due to heavy reduction in price by the sole concern producing this substance. The production of calcium carbide increased from 860 short tons, valued at $48,000, to 1925 short tons, valued at $134,750. There were four works engaged in the production of this substance in 1897. A considerable part of the output was exported. The production of ground mica increased from 571 short tons ($9887) in 1896 to 2692 short tons ($38,218) in 1897. The output of sheet mica increased from 17,360 pounds ($12,528) to 92,335 pounds ($45,615). The output of both ground and sheet mica was obtained chiefly from New Hampshire and North Carolina. New Hampshire produced the most ground mica and North Carolina the most sheet.

Convention of the Northwestern Electrical Association.

The steamer "Northwest," with the delegates of the Northwestern Electric Association, left Chicago at 12:30 P. M. June 10, and Milwaukee at 6:30 P. M. the same day. An informal meeting was held aboard during the evening, which was addressed by President Copeland. The programme was announced. On Saturday forenoon, while approaching the northern end of Lake Michigan, the first formal meeting was held. Mr. S. Everett Doane read a paper on "Incandescent Lamps," which was followed by a quite lengthy discussion. The steamer did not reach Mackinac Island until Saturday afternoon, instead of forenoon, on account of fog. There were 127 passengers in the party.

Electric Vehicles in Paris.

The Western Railroad of France has decided to provide electric carriages at its Paris terminus for the use of its patrons. At the Saint-Lazare station there is an electric plant, the output of which is available during the greater part of the day, and the company proposes to utilize this to charge the accumulators in the electric cabs. The railway company has applied to motor car builders to provide a type of electric vehicle to carry four passengers and 331 pounds of luggage, capable of running with safety 31 miles per day. The company will have these cars for a trial of six months.

*The Electrical World, April 30, May 14, May 21, June 4 and June 11.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," May 27.—In this continuation of their serial they discuss the heat losses and give a large, conveniently arranged table of the properties of commercial copper wire, for three gauges, the B. and S., the S. W. G. and the B. W. G.; besides the usual information in such tables they give the diameters of the single and double covered wires; also six columns giving the ohms per 1,000 feet, for every 20 degrees from 0 to 100° C. The tables have been arranged with special reference to convenience in designing electrical apparatus. They give the following factors by which the resistance at 0° C. should be multiplied in order to obtain the resistance at various other temperatures; these constants are as follows: 1,000 at 0° C.; 1.080 at 20°; 1.163 at 40°; 1.250 at 60°; 1.337 at 80°; 1.422 at 100°. A number of curves are also given for the loss in railway motors, the generation of heat in copper, and the results of an insulation test, but these are not referred to in the text, and probably belong to a previous or subsequent installment; two curves are given, showing the relation between the watts per pound and the amperes per square inch, for zero and 100° C., showing the rate of generation of heat in copper wire.

NON-SYNCHRONOUS POLYPHASE MOTORS. Boucherot system. "L'Elec.," May 28.—The conclusion of the description by Brunswick (see "Digest," last week). Various curves obtained from tests are given, and it is claimed that these are the best results obtained at present by any electro-motors of whatever class. The second type is briefly described, and is intended for places which are not as accessible. The third type is described more fully and is intended for localities where it is very difficult to get at the motor; the principle of these is entirely different; the revolving part has two concentric squirrel cage windings, one inside of the other; the outside set of bars has a relatively high resistance and a small coefficient of self-induction, while the inside set has a low internal resistance and a relatively high coefficient of self-induction; the curves of each are given, and the resultant is the sum of the two; to start these motors it is only necessary to close the switch.

MAGNETIC LEAKAGE IN DYNAMOS AND MOTORS.—Rothert. "Elek. Zeit.," May 26.—A long article discussing the subject of leakage as far as it concerns the constructor. He gives the law of the magnetic circuit in the following terms: "Every line of force must be encircled by as many ampere windings as correspond to the sum of the magnetizing forces, expressed in ampere windings, of all the individual parts of its closed path." The magnetic circuits will close themselves through the nearest path of least resistance; this is discussed and illustrated, showing that the law is analogous to Ohm's law. He discusses the leakage in various apparatus; for transformers he uses the well-known Kapp diagram, showing how the leakage may be graphically deduced therefrom; in well constructed transformers the leakage is of very little importance, and he dismisses it briefly. In multiphase motors, which he discusses at some length, the conditions are the same as in the transformer except that the leakage is quite great and the quantities in the diagram are vector quantities; the amount of the leakage in such motors is a very important factor for the constructor; he shows that the solution offered by Kolben some years ago and now generally accepted is not always correct; namely, that the number of "ampere wires" per cm of the periphery of the armatures should not exceed 100 to 150. The results for multiphase motors are readily applied to single-phase motors, in which the leakage is of still greater importance. He then discusses multiphase and single-phase generators, concluding briefly with continuous current machines, which are merely special cases of the others in which the frequency is very small, so that the leakage is in general quite small; for the leakage from the magnets it has been customary to assume a certain leakage factor for each type, but this he shows is not correct, as it will vary quite appreciably in different machines of the same type, depending upon the size of the pole pieces, the air gap, the excitation, etc., and it is therefore better always to calculate the leakage; in one case he found it to be 3 to 5 per cent., and in another 30 per cent. The methods given in the paper cannot be abstracted.

DETERMINING THE THICKNESS OF LAMINATIONS. Dittenberger. "L'Eclairage Elec.," May 28.—A former article by Loppe (see "Digest," July 3, 1897,) described a graphical method to determine the thickness of laminations of alternating current apparatus for which the flux per unit of cross-section, of a transformer core for instance, is a maximum; in the present article the same result is worked out analytically. The equation is deduced which applied to the example given by Loppe gives the same results; in this the loss of energy per unit of volume is taken as 15, the thickness of the insulation 0.7 "tenths of a millimeter," and the thickness of the laminations was then found to be 0.4 m. m.; moreover, the equation shows that this thickness varies very little for the considerable variations in the loss per unit of volume.

COMMUTATION IN DYNAMOS. Girault. "L'Ind. Elec.," May 10.—A continuation of his mathematical article, which was noticed in the "Digest" May 21; he discusses the resistance of the connections and of the brush contact, developing formulas. No general conclusions appear to be drawn in the present portion.

TEST OF A SHUNT MACHINE.—Lond. "Elec. Eng.," May 27.—Brief accounts of an efficiency test and of the steam consumption of a direct driven continuous current shunt machine.

ALTERNATING-DIRECT CURRENT GENERATORS.—"Amer. Elec.," June.—A description of the system of current generation in which an alternating-current and direct-current machine are combined in one structure. The chief advantages are in connection with long-distance electric railways, where it is desired to supply direct current from the power station directly to the railway, and also to run rotary converters in sub-stations at distant points on the line. In this case direct current is supplied to the feeders at one end of the machine; alternating current is taken from the other end, stepped up, transmitted to the sub-station and stepped down for the operation of rotary converters, which supply direct current to the railway feeders.

CURRENT TRANSFORMERS. Child. "Elec. Eng.," June 2.—In this second installment of his serial (see "Digest," last week,) he discusses the rotary transformer, including information which he has already given in his joint article with Woodbridge, published in the "Elec. World," January 1 and February 12. A brief description of Hutin and LeBlanc's panchahuteur is given; phase transformers and methods for transforming single into polyphase currents are briefly referred to.

TRANSFORMING SERIES INTO SHUNT MACHINES.—"Amer. Elec.," June.—Instructions are given for transforming series dynamos or motors to shunt machines. In the case of arc machines the ampere turns for the shunt field should be reduced about 20 per cent., on account of over-saturation of the arc field.

ARC DYNAMO AIR BLASTS. Watts. "Amer. Elec.," June.—A criticism of an article in the preceding issue on the repair of the air blasts of T.-H. arc dynamos. He finds it much better to dispense with blowers on the machines altogether, and to use a separate air pump, with a reservoir for a pressure of 100 pounds, fitted with a regulating valve to reduce to 10 pounds; each machine is piped to this reservoir, and has a pair of nozzles with openings of 1-64th of an inch; he believes that any company operating more than a few arc dynamos should install a pneumatic outfit as above, but should avoid the use of small steam direct-acting air compressors.

DESIGN OF ONE-HALF HP MOTOR. Poole. "Amer. Elec.," June.—Instructions are given, together with eleven working drawings, for the construction of a one-half hp 110-volt motor with drum armature.

Lights and Lighting.

TESTS OF JANDUS LAMP.—"Zeit. f. Beleucht.," May 10.—A copy of a brief report from a German railroad company. This is followed by a table giving the results of measurements by Prof. Dietrich, made with such a lamp of 5 amperes at 110 volts, the light being measured at twelve different angles with the horizon, both above and below; it gives the candle power, current and voltage. The mean spherical intensity was 193 candle-power, or for the lower hemisphere, 276; for the lower hemisphere the consumption was at the rate of 1.94 watts per candle; 29.5 volts are lost in the regulating coil and resistance, leaving 78.4 for the arc.

TRAIN LIGHTING.—"Zeit. f. Beleucht.," May 10.—The third installment of this serial giving statements of the cost; it is based on German practice, and gives actual figures. Of the 1723 post office cars in Germany, 1108, that is 64 per cent., are provided with electric light; all new cars are to be lighted in this way.

220-VOLT LIGHTING SYSTEM. Shepardson. "Amer. Elec.," June.—Forty-six arguments are given in favor of the 220-volt lighting system, and twenty-nine against, a discussion of them following. A comparison is made between the 220-volt and alternating-current systems for small towns, somewhat to the disadvantage of the former. Some figures furnished to the writer of the article by a firm of engineers seem to indicate that for equally well-made apparatus the alternating-current system is cheaper in first cost; but it is added that it should be remembered that a large number of 220-volt plants have been sold, which are operating very satisfactorily and seem to be paying excellent dividends.

CARBONIZATION OF FILAMENTS. Howell. "El'ty," June 1.—A reprint of the article noticed in the "Digest," June 4.

NAVAL MARINE ELECTRIC LIGHTING. Countiss. "Amer. Elec.," June.—A profusely illustrated article showing the special fittings used aboard men-of-war, with descriptions of special electrical apparatus for signalling.

TEMPERATURE OF INCANDESCENT LAMPS. Janet. "El'ty," June 8.—A reprint of the translation noticed in the "Digest," June 4.

Power.

ELEVATORS. Hawtayne. Lond. "Elec. Rev.," May 27; begun in Lond. "El'ty," May 20.—An abstract of a paper read before the Northern Society of Electrical Engineers. He describes several systems, with special reference to the starting and stopping devices; most of it refers to the Otis elevator, but the abstract contains little information; a small pilot motor is used, operated by two push buttons, one for the up and one for the down motion; the car stops automatically at any required floor; no relays are required. In concluding he gives the results of tests made of two typical Otis elevators, one in an office building and the other in a private house; the weight, time, current, and costs are given for a number of different loads.

WATER-POWER PLANT.—Lond. "Elec. Eng.," May 27.—A brief illustrated description of a small 13-hp plant at a private summer residence.

BLAST-FURNACE GAS. Greiner. Lond. "Elec. Eng.," May 27.—The beginning of a reprint of the paper on the Belgian furnace, an abstract of which was noticed in the "Digest" June 4.

UTILIZATION OF BLAST-FURNACE GASES. Booth. "Eng. Mag." June.—An article giving more in detail the results of his tests at the plant of the Glasgow Iron Company, at Wishaw (Great Britain), where electrical current is generated by gas engines operated with this gas. The subject in general is also discussed and some analyses of gases are given. The blast furnaces of the United States would develop more than 2,000,000 horse-power continuously on his estimate of 10 horse-power per weekly ton of fuel; the estimated cost of the utilization plant and 30 miles of transmission line is less than $60 per electrical horse-power. (Another article by the same author was noticed in the "Digest" May 14 and 28.) The same journal contains a brief reference to a recent paper by Leurmann read before a German society, noticed editorially in the "Iron Age," which takes the position that furnace managers in the United States will not rush into this field, however temptingly it is described by those who admire gas engines but know little concerning the conditions governing blast furnace work. Leurmann contends that these gases contain dust and injurious vapors, and that if this method would be used the gas engine companies would be totally swamped with orders; his views were not generally accepted by his hearers.

ELECTRIC POWER FOR WARSHIPS. Roller. "Amer. Elec.," June.—It is pointed out that the auxiliary steam engines used aboard ships are extremely inefficient in the consumption of steam pumps, taking as high as 250 to 300 pounds per hp-hour, and engines for running dynamos, ice machines, etc., consume from 70 to 110 pounds. He therefore favors the use of electric motors for all purposes except driving the propelling machinery. Another advantage beside economy is greater safety from water-tight bulkheads not being impaired by the passage of steam pipes and ventilating air ducts. For many purposes, such as driving ventilating fans, it is considered that alternating-current induction motors will be preferable, owing to the simplicity and ability to withstand the roughest usage. Direct-current motors have often been injured after a few months' run, owing to improper brush setting and too rapid starting, both of which are impossible with the induction motors.

FACTORY POWER AND HEATING PLANT.—"Amer. Elec.," June.—A description of a plant recently installed at West Evanston, Ill., for the manufacture of woven wire, in which all machinery is run by electric motors.

ANIMAL HORSE-POWER. Cottrell. "Amer. Elec.," June.—In substituting electric motors for horse-powers, care should be taken to know the conditions under which the horses work. In horse-tread mills the animals are often driven almost up to a trot, at which speed the horses can work but a short time, but develop in a given time more than double the amount of work represented by the number of horses multiplied by the time.

Traction.

MOTORS FOR RAPID ACCELERATION. Carus-Wilson. Lond. "Elec. Eng.," May 27; begun in Lond. "Elec.," May 27.—A reprint of his Institution paper on "The Design of Electric Railway Motors for Rapid Acceleration." The paper is largely mathematical in character, and does not admit of being given in abstract; he deduces curves and equations, with the aid of which he discusses the subject. Beginning with a formula for the torque he deduces what he calls the "induction curve" (see next abstract below), from which the curve of total torque for different currents can be obtained; another formula gives the acceleration in terms of the dimensions and data of the motors. The rating of a motor in horse power gives no indication of its ability to accelerate, although this may be its most important function; the horse power at starting is zero; he prefers to define the action of a motor in terms of a force unit instead of a power unit. The distance covered by a car may be divided into a period of acceleration and one of uniform speed; the relations of these two are then discussed, and he determines the conditions for which the time occupied in transit will be a minimum; this he finds to be the case when the distance traveled during the process of acceleration is equal to that traveled during full speed, the time of acceleration being two-thirds of the whole time; when the time and the distance is given it follows that the accelerating current will be less when half the distance is covered during the acceleration; a certain ratio of the data of the motor is determined by this, and it governs the design of the whole equipment. He discusses the influence of the series windings on the curves of current and acceleration, showing that while any one of a number of curves would comply with a specification as to time and distance, there is one which is better than the others; the saving effected by the use of series windings is pointed out. He shows that by rightly proportioning the gap and the velocity ratio, results may be obtained which approach very nearly to the greatest possible economy. To illustrate the application of these principles to heavy railway work he applies them to the Metropolitan road in Chicago. The force of the motor may be conveniently expressed as the product of the current and the corresponding induction factor; he shows the application of this with curves. In conclusion he considers the relative economy of a gearless equipment, and finds that with geared motors the expenditure of energy is about 5 per cent. less than with gearless of 4 times the weight; he shows the economy of having down grades from the starting points and in an example taken a saving of about 35 per cent. for the geared motor and 28 per cent. for the gearless is obtained.

ELECTRIC TRACTION. Carus-Wilson. Lond. "Elec. Eng.," May 27.—A brief abstract of his recent Canton lectures, a reprint of which is promised in that journal. He referred at some length to what he calls the induction factor of a railway motor, which he represents by M and which is equal to p A N multiplied by 10 to the minus 8th power, in which p is the number of pairs of poles, A the total number of surface conductors, and N the useful lines of force per pole. This factor has an important bearing on the series parallel control because it is by varying M that the various speeds and torques may be obtained without the use of variable speed gear. The parallel, the series and the series-parallel systems of control are compared as in use on the Liverpool, the City and South London, and the Chicago railways, respectively; the all-series method takes longest for the car to get up to full speed; for runs of greater distances than 2,000 to 3,000 yards the method of connecting up the motors does not make much difference. The lectures were profusely illustrated with curves, among which are analyses of the energy lost in the controller, in acceleration, in frictional resistance, etc., none of which are reproduced in the abstract.

EUROPEAN RAILWAY STATISTICS.—Lond. "Elec. Rev.," May 27.—A reprint of the table noticed in the "Digest" April 23, showing the extensions in different countries and the various systems used; Germany is far in the lead, followed by France, Great Britain and then Switzerland.

ELECTRIC RAILWAYS IN AUSTRIA.—"Zeit. fuer Elek.," May 22.—Statistics for the first quarter of the present year, showing the traffic and receipts.

HISTORY OF ELECTRIC TRACTION. Gerard. "L'Eclairage Elec.," May 28.—An abstract from his recent publication giving the early history prior to the development of the trolley system in the United States.

POWER DISTRIBUTION IN RAPID TRANSIT SERVICE. Armstrong. "St. Ry. Jour.," June.—The author discusses with great care the question of the most desirable speed of acceleration on electric lines to secure a minimum expenditure of energy. A sample line 1 mile in length is considered with the constants of 20 pounds per ton train friction and braking effort of 150 pounds per ton. Speed diagrams are drawn out at various rates of acceleration, and the corresponding energy curves are also shown. The efficiency of the motors and the methods of control are intentionally omitted by the author in the consideration. The article tends to show an economy in a high rate of acceleration with consequent long coasting period and short braking period.

PROPER SPEED FOR RAILWAY MOTORS. Cravath. "Elec. Eng.," June 2.—A short article against the present practice of using high-speed motors. He states that "to produce a given torque or acceleration, the current required varies directly according to the maximum speed for which the motor equipment is geared"; also "that the heating of the motor producing a given torque or acceleration varies directly as the maximum speed for which the motor is geared." The principal work done by motors in all classes of railway service is the acceleration, and it is therefore better to select a motor of a speed which will give a high torque per ampere of current; it will take twice as much energy to get a car up to a speed of 20 miles an hour if equipped with motors geared to 40 miles as it would to get the same car up to 20 miles if it is equipped with 20-mile motors, the rate of acceleration being the same in both; moreover, the 40-mile motors will heat twice as much.

LOS ANGELES.—"St. R'y Jour.," June.—A description of the system and methods of the Los Angeles Railway Company. Los Angeles is the largest city in Southern California, and has a population of 108,000, and a length of electric railway track of 74 miles. The system is a consolidation of a number of smaller properties, including an extended cable line which has been changed to the electric overhead system. The station contains one 1200-hp engine, one 800-hp engine, two 600-hp engines, and one 250-hp engine, and supplies power to miscellaneous industries by electricity, as well as power to operate the cars. Petroleum is used as fuel and costs from 70 cents to $1.50 per barrel. During 1897 the station produced 107.15 kw hours per barrel of coal, and the evaporation of the water was 12.89 pounds of water per pound of oil. The method of burning the oil is described; considerable difficulty was had at first with scale forming on the interior of the boilers, due to the impuri-

ties in the water used for steam. In track construction the company is using rails of a length of 60 feet. The power required per car mile varies from 1.3 kw hours on poor track to .94 on good track. A table shows the different headings under which the results of operation are classified.

LONDON'S TRAMWAYS. By a Member of the London Common Council. "St. R'y Jour." (International Edition), June.—In the Tramway Act of 1870, all franchises granted to tramway companies by Parliament stipulated that the municipalities in which the tramways were located should have the option of purchase at the expiration of twenty-one years, and under this law many of the municipalities have recently been securing the properties. The question of the purchase of the London tramways came up in 1895-96, and it was decided in favor of re-leasing the lines to the North Metropolitan Company, which now operates the bulk of the existing tramways in North London, and about half of the entire mileage of the city. The entire mileage in London consists of about 100 miles of double track and 40 miles of single track, or 1 mile to every 31,766 inhabitants. All the lines are operated by horses with the exception of two short cable lines. The question of motive power is now under consideration.

DOVER, ENGLAND.—"St. R'y Jour." (International Edition), June.—This line has been in operation about eight months, and is owned by the municipality of Dover. The power is rented from the lighting plant at a cost of from 6 cents to 5 cents per kw hour; the railway engines are of the horizontal tandem compound type, and the generators are 100 kw each; the cars are equipped with watt meters, which show the amount of current consumed by each; the trolley wire is carried at the side of the street and not in the centre, and the trolley poles are of a type adapted to this position; the rails are mounted on a continuous block of cement concrete; there are eight motor cars and two trail cars; each motor car has two 25-hp motors.

MONTEVIDEO. Wardlaw. "St. R'y Jour.," June.—The writer states that even with coal costing $8 in gold per ton, as is the case in Montevideo, electric operation is cheaper than tramway operation by horses. He has made some investigation on this subject, and found the cost per car mile with horses during the past year was $0.0917, whereas with electricity it would be $0.078. While fuel is more expensive, labor is less expensive; snow is unkonwn, and open cars can be used throughout the year.

VIENNA STADTBAHN. Ziffer. "St. R'y Jour." (International Edition), June.—The total length of the new line to be built is 46.7 km.; the line will include both heavy trunk lines and branch lines. He gives a list of the various sections to be built, with the estimated cost. A map of the line section of the rail joint to be used and one of the car to be employed are given. The line will be operated at present by steam, but a test will be made with electric cars using the third rail, and if successful the system will be extended over the entire line.

POWER STATION.—"Power," June.—A well illustrated description of the changes recently made in the Albany street station of the West End Railroad Company, of Boston, in which direct-driven units have replaced those formerly driven by belts.

STORAGE BATTERY LOCOMOTIVE FOR TRUNK LINES.—"St. R'y Jour." (International Edition), June.—A description of a car recently put in operation on one of the trunk lines of the Royal Wurtemburg Railroad (Germany). It is equipped with two 35-hp motors, and carries a storage battery between the two trucks.

MOVABLE ELECTRIC BRIDGE.—"El'ty," June 1.—Brief editorial notice of the suggestion which has been made to build a sort of submerged railway across the English Channel, the cars consisting of a large platform above the surface of the water, the tracks being submerged 49 feet and the motive power being electricity; the cost is estimated to be about $70,000,000.

ELECTRIC LOCOMOTIVE TRUCK.—"St. R'y Jour.," June.—A description of a truck built for the Paris, Lyons & Mediterranean Railroad for carrying a double truck electric car weighing complete 96,000 pounds. The car will be equipped with four 150-hp motors, making a total of 600 horse-power. Special care was taken in the design of the truck to make it easy riding, and it is of quite a novel construction.

ELECTRIC RAILWAY DEVELOPMENT IN JAPAN. Fujioka. "St. Ry. Jour." (International Edition), June.—Abstract of paper read before the New York Electrical Society. Tokyo has a population of 1,500,000, but at present jinrikshas supply almost the only means of communication. The Government has recently granted franchises to two electric railway companies, which will build about 300 miles of track. One 8-mile horse line has just been converted to electricity; water-power is used to generate current. A list of the proposed lines is given.

EARTH RETURNS FOR ELECTRIC RAILWAYS. Parshall, Trotter and Cardew. "St. Ry. Jour.," June.—Reprints of the three (London) Institute papers, which were noticed in the "Digest" May 21.

GROUND CURRENTS FROM RAILWAYS. Herrick. "Eng. Mag.," June.—A short article of an elementary nature discussing the action of ground currents, describing the evolution of the rail bond, showing how the currents in water pipes may be determined, and describing some of the remedies.

ELECTRIC RAILWAY ENGINEERS IN EUROPE.—"St. Ry. Jour." (International Edition), June.—Independent consulting engineers are more numerous in England than in any other European country, and occupy there positions of great influence in determining the type of apparatus to be used. Some particulars are given of a number of the most prominent English electric railway engineers.

Installations, Systems and Appliances.

LOAD FACTOR. Ellington. Lond. "Elec.," May 27.—A discussion of the proposition of Hammond concerning the definition of the term load factor (see "Digest," June 4). He claims that this term ought not to be confined to central station work, but should be of much wider application; what Hammond really wants is a definition of the annual load factor of central stations; in this case he agrees that it is misleading to make it depend on the capacity of the plant, the best basis being the maximum output; this should be the real maxima, however, and not an assumed one; he does not thing an average of the maxima during several periods is an improvement; load factors in any case must have a relation to maximum demands, real or assumed; to include the reserve plant assumes a larger demand than exists, while to average the varying maxima of the year is to assume a demand less than the fact.

DEFICIENCIES OF THE SINGLE-PHASE CURRENT. Scott. Lond. "Elec.," May 27.—Some deductions from the tables in Hammond's recent paper with which he endeavors to show that the single-phase alternating current has been tried and found wanting, and that "it is played out"; he shows its shortcomings in connection with motor loads; the inferiority of single-phase machinery is pointed out, and he states that by merely filling up some of the empty slots in a single-phase alternator, with an extra winding, making it a multiphase machine, its output is increased 15 per cent.; a number of consulting engineers who were formerly prejudiced in favor of the single-phase currents are now preferring other systems; the lack of the possibility of storing the energy is greatly against their use; high-voltage lamps also effect the change in favor of continuous currents.

THREE-WIRE ALTERNATING SYSTEM. Meyer. "Elek. Anz.," May 26.—A description of his system, in which the three-wire portion begins at the secondary transformer coils, the primary distribution being on the two-wire system. There are two coils in the same transformer, the neutral wire being connected to their junction; the balancing is produced by two transformers, the primaries of which are connected respectively to the two branches, and the two secondaries are connected in series with each other; when the system is balanced the two secondary currents in these transformers will balance and neutralize each other, but when the balance is destroyed it will be compensated by these transformers.

RELATIVE MERITS OF TWO AND THREE-PHASE SYSTEMS IN LARGE FACTORIES.—Lond. "Elec. Eng.," May 27.—An answer to a request to point out the relative merits of the systems when both light and power are to be supplied.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," May 27.—An analysis of the accounts of the Douglass Southern Railway Company, the Isle of Man Railway & Power Company and the Shoreditch station.

AUTOMATIC REGULATOR. Ferrand system. "L'Elec.," May 28.—A brief illustrated description of a regulator for dynamos or lights. It consists of an inclined pile of carbon discs, on which a variable pressure is exerted at the bottom by means of a lever acted on by a weight, which is counterbalanced by the attraction of an electromagnet; the latter is wound as a shunt or a series magnet, according as the voltage or the current is to be kept constant; when used for regulating dynamos the carbon pile is in series with the exciting current and the coil is attached to the constant-potential circuit which is to be regulated. In an experiment he varied the speed of a 100-ampere dynamo from 1000 to 2000 revolutions, during which time the regulator kept the potential constant.

CUT-OUTS.—"L'Energie Elec.," May 26.—In a number of brief descriptions of various apparatus at the recent exhibition of the French Physical Society, illustrations with brief descriptions are given of an automatic switch for high-tension primary currents, an interrupter for a maximum current and another for a minimum current.

DEVELOPMENT OF THE CENTRAL STATION. Insull. "West. Elec.," June 4 and "Elec. Eng.," June 9.—The second portion of the reprint of his lecture (see "Digest" last week). He favors the low-tension system as distinguished from the house-to-house converter system; considerable detail is given in connection with his station in Chicago, in which he claims that current is more economically produced than in any similar one in the country; the cost, in its relation to the interest, is discussed; the value of the storage battery is recognized, and he concludes after a careful investigation that it is economical to use storage batteries in stations in which the peak does not exceed 2 to 2.5 hours, and as this is the case in most stations, a battery will generally prove to be an economical factor.

COST AS RELATED TO OUTPUT.—"Am. Mach.," June 2.—A reprint of the final pair of the diagrams of Hammond's recent paper (see "Digest," April 23, May 7 and 21); these diagrams give the relation of all the elements of cost per unit, to the total output sold, for each of a number of stations and succession of years.

REGULATING ALTERNATING-CURRENT LINE VOLTAGE.—"Amer. Elec.," June.—The principles are described of a sys-

tem of regulating the voltage of alternating-current transmission lines by means of over-excited synchronous motors or rotary converters in circuit. It is shown that with an over-excited field the current taken may be made to lead the impressed E. M. F., thus giving the motor an action equivalent to that of a condenser; the amount of the condenser component of the E. M. F. may be so regulated as to neutralize the line inductive drop, or the sum of this and the resistance drop; or the voltage of the line immediately beyond the motor may be raised above that of the voltage at the generator; in the second and third cases it is necessary to place in the main line a choke coil, its value depending upon the value of the ohmic drop in one instance, and in the other upon the sum of the ohmic drop and the over-compounding desired. It is pointed out that the neutralization or over-compounding refers to the terminals of the motor or conductor; that is, the voltage at the terminals is the impressed E. M. F. of the line beyond; consequently, to regulate the close regulation of the voltage of a long line will require more than one motor or converter in circuit.

ST. LOUIS. Wagner. "Elec. Eng.," June 9.—A very long, profusely illustrated description of this single-phase alternating current station, which it is claimed represents the highest development thus far reached in such a system in this country, if not in any other. As one of the fundamental principles for success he claims that the alternators must be operated in synchronism; he uses single-phase motors for power work and claims that they are satisfactory; arc lamps are run in series on the same circuits, with the use of a constant current transformer.

ARC LIGHT PLANT.—"Amer. Elec." June.—A description of the new arc light plant of the Brooklyn Edison Electric Illuminating Company. This plant displaced a steam plant operated by five engines of 400 horse-power and one of 1200 horse-power; in addition two 150-hp direct-current motors were used during hours of heavy load; only a fraction of the space occupied by this machinery will be required for the new plant, which will consist of 100-kw synchronous motors, running at 750 r. p. m., each motor having directly connected to it two 125-light arc machines, having a rating of 6000 volts and 6.6 amperes; four of these units are now installed in the station. There will also be two rotary converters of 200-kw capacity, which will charge a storage battery of 156 cells, having a capacity of 600 amperes for one hour; this latter plant is for the case of break down of the 6000-volt transmission lines, in which case the battery will discharge into the rotaries, which will deliver low-tension three-phase current to the transformers, which in turn will deliver to the synchronous motors the 6000-volt current necessary to their operation. A three-machine booster will be used in charging the batteries, the motors in the middle with a dynamo on each side having each a capacity of 1000 amperes at 50 volts.

GAS ENGINES, CENTRAL STATION. Flather. "Amer. Elec.," June.—A description of a central station employing two 125-hp three-cylinder vertical gas engines belted to 60-kw two-phase, 2000-volt dynamos, and running at 900 r. p. m. A power circuit is supplied by a four-pole rotary converter, running at 1800 r. p. m. and furnishing direct current at 500 volts. The converter is brought into synchronism by starting with a greatly reduced voltage and gradually increasing by successively changing the plug connections at the switchboard by means of two four-pole switches, the secondary on the transformer being suitably divided into sections to permit this. There is a water-cooling tower to cool the water from the gas engine cylinder jackets.

STORAGE BATTERY CENTRAL STATION. Sage. "Amer. Elec.," June.—Description of a small central station at Claremont, N. H., run by water and steam power combined. One hundred and thirty-four cells of storage battery of 400 ampere-hours each are used. Previous to the installation of the battery it was necessary to run an auxiliary steam engine about 180 hours per month to supplement the water wheel; since then the engine is run only about thirteen hours per month, and usually the machinery is operated only six hours per day.

CHICAGO STORAGE BATTERY PLANT.—"Elec. Rev.," June 1, and "West. Elec.," June 4.—Illustrated descriptions of this plant, a brief description of which was given in the "Elec. World" last week.

SWITCHBOARD RECONSTRUCTION. Herrick. "Amer. Elec.," June.—Instructions are given for reconstructing old-style switchboards to make them conform with modern practice. A number of illustrations are given, showing the construction of home-made switchboard details.

Wires, Wiring and Conduits.

RULES AND REGULATIONS.—"Elek. Zeit.," May 26.—A reprint of an official document in which certain recommendations applying to alternating current systems are made; the recent fatalities due to low-voltage alternating currents have given rise to these suggestions. It is recommended that all frames of machines and apparatus be earthed; the mechanism for raising arc lamps should also be earthed, and there should be provisions for preventing this mechanism from coming in contact with the circuits; switches should be provided with metallic cases, which should be earthed; the use of portable incandescent lamps is to be avoided as much as possible, and if they must be used the wires should be covered with a rubber tube; all fuses should be easily accessible and so arranged that a fuse can be changed without danger; arc lamp circuits should be fused at each pole; all circuits should be enclosed by metallic earthed coverings up to a height of 8 feet.

WIRING PRACTICE. Bathurst. Lond. "Elec. Eng.," May 27.—A reprint of a paper on the wiring of houses, in which he describes and shows the advantages of tubes or conduits of armored insulating material, which he believes meet the requirements of a perfect system.

PROPERTIES OF COMMERCIAL COPPER WIRE.—See abstract of Parshall and Hobart's article under "Electric Generators."

UNDERGROUND DISTRIBUTION. Jehl. "Amer. Elec.," June.—The various systems of underground distribution employed in Europe are described and illustrated. The writer strongly favors the method of laying armored cables on sand in trenches, common bricks being laid on top as a sufficient safeguard against picks, etc. This system, he says, is most generally used on the Continent, and has given excellent satisfaction; besides being cheaper, the armored cables can be laid in a fraction of the time necessary when conduits are used; a contractor is quoted as stating that he is laying in this manner 23 miles of cable in Brunn in about as many days, while if he had that length of gas pipe to lay with the same number of men it would take over a year; still another advantage is that armored cable need not be laid in straight lines, and obstructions such as sewer, manholes, etc., can be dodged. The life of an armored underground cable is said to be thirty years, and Siemens & Halske consider that 1.49 per cent. of its cost is sufficient to put in an annual depreciation fund. The writer notes that in England, as on the Continent, armored cable takes the lead, stoneware and iron pipe systems being about equally divided in that country.

MOST ECONOMICAL SYSTEM OF CONDUCTORS. Herrick. "Elec. Eng.," June 9.—A short article, accompanied by a chart in the form of a double page supplement containing numerous curves for finding the best conductor system that can be devised to supply fixed centres of distribution with the least first cost and energy loss; knowing the amount of power required to be delivered at a given distance, this chart is claimed to show almost at a glance which system is best adapted to the conditions. In the case of alternating currents the cost of the transformer is included, but the all-day losses in it are not. The distance that a given weight of copper will extend a distribution is shown; the curves also show which system will return the maximum revenue with a fixed consumption circuit.

CABLES WITH AIR CIRCULATION. Barbarat. "El'ty," June 1.—A reprint of the article noticed in the "Digest," June 4.

INTERIOR WIRING. Knox. "Amer. Elec.," June.—The current installment of this series relates to the control of lights. Two and three-circuit arrangements, and circuits for outlets to be controlled from two or more points, are described and illustrated.

PREVENTING INTERRUPTIONS IN SUPPLY. Andrews. "El'ty," June 8.—A reprint of the paper noticed in the "Digest" May 28 and June 4.

Electro-Physics and Magnetism.

CATHODE AND ROENTGEN RAY TUBES. Villard. "L'Eclairage Elec.," May 28.—An abstract of a French Physical Society paper describing improvements. One of these is an anti-cathode which does not blacken the tubes; iridium is very satisfactory if quite pure, but the commercial variety is not pure enough; the new anti-cathode is in the form of a paraboloid with a lateral opening through which the cathode rays enter; this will not blacken the tube, because it never acts as a cathode for the reversed currents; the form of the anode, creating an electrical field which is practically zero in its interior, totally prevents the formation of these new rays. He also describes a tube which may be regenerated; part of the tube consists of a small tube of platinum closed at one end and joined at the open end with a glass tube; nickel or palladium will also answer; to regenerate the tube this metallic tip is heated in a Bunsen flame; at about 1,000° hydrogen passes through the platinum, but it is absolutely impenetrable to air. He also mentions some magic screens on which the images are preserved, but the description is not quite clear.

NODES IN CATHODE RAYS. Wiedmann and Wehnelt. "Wied. Ann.," 64, p. 606; abstracted in the "Elek. Zeit.," May 26.—An abstract, with some of the illustrations, of the article noticed in the "Digest," April 30.

ELECTROSTATIC PROPERTIES OF CATHODE RAYS. Lenard. "Wied. Ann.," 64, p. 280; abstracted in "Elek. Zeit.," May 26.

THORIUM RAYS. Schmidt. "Wied. Ann.," No. 5; abstracted at some length in "L'Eclairage Elec.," May 28, and more briefly in the Lond. "Elec.," May 27.—He gives the results of a close study of rays emitted by thorium and its compounds; they are not identical with those obtained from uranium.

FLUORESCENCE AND ACTINIC ELECTRICITY. Schmidt. "Wied. Ann.," No. 4, p. 708; noticed briefly, with the conclusions of his researches, in "Am. Jour. of Sc.," June.—He endeavored to find whether the three phenomena, ionization, fluorescence and actino-electricity, are connected.

THE ARC IN LIQUIDS. Bredig. "Zeit. f. Elektrochemie," May 20.—A report of a short paper read before the German Elektrochemical Society, in which he describes some experiments in the formation of endo-thermic materials. With the arc under petroleum he obtained a gas having high illuminating power and containing 6

to 8 per cent. of acetylene; he does not think the method is commercially applicable at present. Another interesting phenomenon was shown, if an arc is made between metallic wires under water the metals will be divided into an extremely fine dust, so fine that with the noble metals they will pass through the filter; the results were obtained with zinc, lead, silver, platinum and gold. The explanation is that the vapors of these materials are rapidly condensed by the cold water. By this means very finely divided platinum having a strong catalytic action can be obtained without the use of chemicals.

CHANGE OF RESISTANCE DUE TO AIR OSCILLATIONS. Auerbach. "Elek. Zeit.," May 26; abstracted from the "Wied. Ann.," 64, p. 611. He shows that acoustic oscillations, such as those produced by a tuning fork, will affect the change of resistance of a coherer, like electric oscillations.

COHERER.—"L'Eclairage Elec.," May 28.—A quotation from a publication in April, 1894, showing that Le Royer and van Berchem used the Branly tubes of filings for indicating the presence of Hertzian oscillations, which has generally been thought to have been done first by Lodge later in the same year.

ETHER. Shettle. Lond. "Elec. Eng.," May 27.—A short article giving his theory of the constitution of the ether; he considers that "the ether is the residue of the primary unformed stuff, and was left after the formation of matter by condensation."

GRAPHICAL CALCULATION OF ALTERNATING CURRENTS. Guye. "L'Eclairage Elec.," May 28.—The second part of his series, which is in the nature of a brief treatise on the subject.

MAGNETIC IMAGES. Jaeger. "L'Eclairage Elec.," May 28; abstracted briefly from the "Wied. Ann.," 63, p. 137.—He showed that S. P. Thompson's magnetic images also existed when the coil was replaced by a wire; it is also applicable to constant currents and to constant fields.

STRATIFICATION IN GEISSLER TUBES. Gill. "Am. Jour. of Sc.," June.—A long, illustrated article, in which he offers a theory to explain the stratification of the electric discharge in such tubes, and he describes some experiments which have been made to test this theory. Briefly his theory is that the discharge, being discontinuous, produces periodic disturbances in the gas and these are propagated like sound waves, the stratification being the nodes caused by these waves; the phenomenon is similar to that of the well-known Kundt experiment in acoustics.

CATHODE RAY SPECTRUM. Birkeland. "El'ty," June 1.—A reprint of the article noticed in the "Digest" June 4.

IMPROVED X-RAY TUBE. Sayen. "Jour. of Frank. Inst.," June.—A reprint of a recent paper describing his improved tube, a description of which was published in the "Elec. Rev." about a year ago; there seem to be no improvements in the present form.

X-RAY SWITCH. Kolle. "Elec. Eng.," June 2.—A brief illustrated description of an improved form of his switch, which facilitates the reversing of the primary current.

ALTERNATING CURRENTS. Dommerque. "Elec. Eng'ing," June 1.—Another installment of his very long serial on the elements of complex quantities and vectors with reference to their use in alternating-current work; the present portion refers to the deduction of the sine law for E. M. F. and current, and is mathematical in character.

TERRESTRIAL MAGNETISM. Bigelow. "Am. Jour. of Sc.," June.—Some comments on Bulletin No. 21 of the United States Weather Bureau on solar and terrestrial magnetism in their relations to meteorology, in which he brings out more prominently the important features of the subject as now understood.

Electro-Chemistry and Batteries.

PRODUCTION OF CHLORATES.—"L'Ind. Elektrochimique;" abstracted in "L'Eclairage Elec.," May 28.—A brief description of the Spilker and Loewe electrolyzer, which is used in an installation in Leopoldshall, where chlorine and soda are produced. A dilute solution of chloride of potassium is used; in the centre of the tank is a porous cup filled with that solution saturated with chalk and containing the anodes of lead and carbon; the solution is introduced continuously in the top of this cup, and at the bottom the liquid containing the hypochloride of chalk is drawn off, while at the top a solution of caustic potash is formed; the former is led into a tank containing chalk, forming oxychloride of calcium; no free chlorine is produced if the circulation is sufficiently rapid; at 40° C. chlorate instead of hypochlorite is formed.

ELECTROLYZER FOR HYPOCHLORITES.—"L'Eclairage Elec.," May 28.—A brief reference to the Brochoki electrolyzer, which has been submitted to severe tests; the results obtained are given briefly. The apparatus itself consists of five compartments at decreasing levels, so that the liquid from the first flows into the second, and so on through the series; it contains sheets of lead and platinum, as the electrodes and the liquid are made to circulate between them; the voltage is 5 and the current density 3 amperes per square decimeter.

ELECTROCHEMICAL INDUSTRIES AT FOYERS. Wallace. Lond. "Elec. Rev.," May 27.—A brief abstract of a paper on the work done by the Aluminum Company of that place. He states that the company is able to develop electrical energy, including all costs and interest, at less than one-third the cost when produced by steam. The practical yield is 1 pound of aluminum metal per 12-electrical-hp hours. Lord Kelvin's latest results from the resistance of 99.69 per cent. pure show 6.997 x 10 to the minus 6th power ohms, per length of wire weighing 1 gramme at zero degrees C.; or 2.58 michrohms per cubic centimetre; comparing this with copper the conductivity of aluminum volume for volume is 60.5 per cent., and weight for weight double that of copper. Very little information is given in the abstract, it being chiefly a synopsis of the paper.

ELECTROCHEMICAL INDUSTRY. De Fodor. "Zeit. fuer Elek.," May 15 and 22.—A reprint of a lecture of a general character, reviewing recent progress.

METHOD OF SEPARATING COBALT AND NICKEL. Coehn. "Zeit. f. Elektrochemie," May 20.—A reprint of a short paper read at the meeting of the German Elektrochemical Society. The method is not very clearly described; it is based on a peculiar electro-capillary phenomena; in his experiments he used a glass tube, sealed at one end, which had been plunged into water while quite hot, thus producing numerous capillary cracks; one electrode is on the inside, and the other on the outside; several experiments with such a tube are described; he showed that nickel and cobalt may be readily separated; moreover, this method might be used for obtaining pure cobalt; the qualitative tests of the slightest traces of cobalt in nickel solutions is very easily carried out in this way.

FRACTIONAL REDUCTION OF NITRO-BENZOIL. Haber. "Zeit. f. Elektrochemie," May 20.—A reprint of a long paper read before the German Elektrochemical Society; it is chiefly of interest to chemists.

CONSTITUTION OF MERCURY. Liebenow. "Zeit. f. Elektrochemie," May 20.—A reprint of a paper read before the German Elektrochemical Society. After calling attention to his previously published theories regarding the constitution of metals, he endeavors to show that mercury is an alloy of mercury molecules of single and multi-valency, in which those of a single valency are contained in excess.

FURNACE. Borchers. "Zeit. f. Elektrochemie," May 20.—A reprint of a short paper read before the German Elektrochemical Society, describing a universal laboratory furnace, which is adapted for all the various purposes; it can readily be changed from one in which the heating is done by incandescence to one in which it is done by the arc.

MODERN THEORIES OF ELECTROLYSIS. Hollard. "Rev. Gen. des Sciences," May 15.—The first part of a very long article, in which he gives the present state of the theory of electrolysis, limiting himself to the electrolysis of aqueous solutions of metals. In the present portion he discusses the constitution and conductivity of electrolytes, and in the second half he will discuss the energy of electrolysis.

LECTURE EXPERIMENT. Kuester. "Zeit. f. Elektrochemie," May 20.—A reprint of a short paper read before the German Elektrochemical Society, in which he describes a lecture experiment showing to how great an extent the potential difference of copper toward copper solutions depends on the concentration of the copper ions in the solution.

FULMEN ACCUMULATOR FOR TRACTION. Hospitalier. "L'Eclairage Elec.," May 16.—A reprint of a short article giving some data for this accumulator, with special reference to its use on electric carriages; it appears that the results are those of a test made by him. There are thirteen plates in a cell, and they are separated by perforated celluloid; the weight complete per cell is 7.5 kg (16.5 pounds); the results are as follows: 3 amp. per kg; 5.3 watts per kg; 146 amp. hours per kg; 26 watt hours per kg; 190 kg per kw; 37.5 kg per kw hour; the weight referred to is the complete weight of the cell; the normal discharge rate is five hours; he adds that these figures are the best that have been obtained with present accumulators; it is now possible to run electric carriages from 50 to 60 km per day with one charge.

RULES IN ACCUMULATOR FACTORIES.—"Elek. Zeit.," May 26.—A reprint of a long set of rules which has just been issued in Germany to protect the health of the employees in factories where accumulators made of lead or lead compounds are being manufactured.

ANNUAL MEETING OF THE GERMAN ELEKTROCHEMICAL SOCIETY.—"Zeit. f. Elektrochemie," May 20.—The continuation of the verbatim report of the proceedings. The papers will be referred to under separate headings. Hittorf was elected honorary president and van't Hoff president.

MINERAL PRODUCTION OF THE UNITED STATES IN 1897.—"Eng. & Min. Jour.," May 28.—A carefully compiled table of statistics, some of the information in which is of interest to electrical engineers. The aluminum production in 1897 was 4,000,000 pounds, valued at $1,400,000, as against 1,300,000 pounds in the previous year; the increase was due partly to the reduction in price and partly to an increased export trade. The copper production was 510,190,719 pounds, as against 479,806,183 in 1896. The table contains a list of eighty-nine mineral products, with the quantities and value of each for both years.

ELECTROCHEMICAL INDUSTRIES IN ENGLAND. Kershaw. "El'ty," June 8.—A brief, illustrated description of the aluminum plant at Foyers and three copper refining plants in England.

Units, Measurements and Instruments.

GALVANOMETERS. Ayrton and Mather. Lond "Elec.," "Elec. Rev." and "Elec. Eng.," May 27.—An abstract of a Physical Society paper, which is a sequel to the one published in the Proceedings of that Society, vol. 10. They suggest that the comparative sensitiveness of galvanometers should be expressed in millimeter scale divisions per micro-ampere when the spot is one meter from the mirror; for the periodic time, that is, the time during two transits across some fixed point on the scale in the same direction, the standard should be 10 seconds; the factor of sensitiveness as regards resistance should be reduced to the common basis of one ohm. A table accompanying the original paper gives complete data for a large number of galvanometers constructed during the past ten years; the most sensitive are the oscillographs. In the second part of the paper they calculate the limiting sensitiveness of galvanometers of the Thomson type and discuss the relative merits of long and short periods, concluding that if the control can be altered and the sensitiveness adjusted, then for rapidity of working the control should be so adjusted that the sensitiveness is approximately two or three times greater than is absolutely needed for the desired accuracy. In the discussion Threlfall thought this method of comparing galvanometers was very misleading, as the sensitiveness obtained by the optical arrangements was entirely ignored; he shows what an important factor this is; incidentally he states that the best diameter for glass mirrors was 1.1 cm, with a weight just under 0.5 gr.; the controlling field for the Thomson galvanometer should be straight and uniform and therefore there should be two magnets, one above and one below the needles. Ayrton admitted that if two instruments of different kinds are compared, the criticism of Threlfall would carry some conviction; but in order to get an opinion of the electromagnetic improvements it is necessary to have some common system of classification.

UNIVERSAL SHUNT. Rymer-Jones. Lond. "Elec. Rev.," May 27.—An illustrated description of the improved form of his shunt, described in that journal two years ago; the improvements are in the direction of cheapening its construction, and the slide proper, together with the so-called vernier slide, are included in one box; he also corrects "an error when speaking of the K-V (probably Kelvin-Varley) slides as not being applicable for a universal shunt."

BOLOMETER. Belloc. "L'Eclairage Elec.," May 28.—A short article in which he describes researches to determine whether the increase in temperature inherent in the use of a bolometer has a measurable effect in precise measurements. He concludes that in using the bridge as a bolometer the compensating wire should be extended into a medium having a constant temperature; also that the current which flows through this wire should always be constant; in any case the absolute measurements of temperature will involve an error which will be smaller the weaker the current. He suggests overcoming the difficulties by using a constant current in the wire and measuring the difference of potential at the ends.

MEASURING THE DIFFERENCE OF PHASE. Rossi. "L'Eclairage Elec.," May 28.—An article describing and giving a theory of a modified method of measuring the difference of phase between two sinusoidal alternating currents by means of the electrodynamic effects. It is a modification of the one devised by Arno; Rossi prefers a method in which two distinct instruments are used; the present apparatus, however, does not require the use of a second instrument; three successive readings are required, thus diminishing the time taken for the readings; the arrangement is more simple than that of Arno, which has two movable suspended coils; in this improved form there are two coils perpendicular to each other, moving with respect to two others, also perpendicular to each other. The instrument can also be used as a wattmeter.

METERS. O'Gorman. Lond. "Elec.," May 27.—In discussing Gibbings' paper on the electrolytic meter (see "Digest," last week,) he calls attention to the defects in this class of meters, most of which are already recognized; one of them is that after the meter is filled there is no longer any record of all the previous readings; since the electrical energy during the heavy load time is worth seven times as much as during light loads, it is seven times more important to read the full load current accurately.

MEASURING THE EARTH'S MAGNETISM. Meyer. "Wied. Ann.," No. 4, p. 742; noticed briefly in the "Am. Jour. of Sc.," June.—He describes a new method of determining the inclination and horizontal intensity; he uses an earth inductor, which is kept in continuous rotation, the neutral position being determined by means of a telephone or capillary electrometer; the inclination can be measured to one-tenth of a degree; the instrument is transportable.

CADMIUM AMALGAM IN STANDARD CELLS. Jaeger. "Wied. Ann.," No. 5; noticed briefly in the Lond. "Elec.," May 27.—An advantage of the Clark cell over the cadmium cell is that the E. M. F. due to zinc amalgam is very nearly equal to that of pure zinc, and is therefore practically independent of the constitution of the amalgam. He investigated the E. M. F. between cadmium amalgams of various strengths in a solution of cadmium sulphate and found that as long as the percentage of cadmium in the amalgam is below 15 the E. M. F. is constant within 10 microvolts; with pure cadmium compared with 14.3 per cent. amalgam, the E. M. F. increased to 0.051 volt; the best amalgam for these cells is therefore 10 per cent., and this should not give rise to any irregularities.

CONDUCTIVITY OF ELECTROLYTES. Kohlrausch, Holborn and Diesselhorst. "Elek. Zeit.," May 26; abstracted from the "Wied. Ann.," 64; p. 417.—An abstract of a contribution from the Reichsanstalt, which was noticed in the "Digest" April 30. The present abstract contains more of the data than the one previously noticed.

FUNCTION OF INDUCTION COIL CONDENSER. Dubois. "Wied. Ann.," No. 5; noticed briefly in the Lond. "Elec.," May 27.—He confirms the results obtained by Mizuno (see "Digest," May 28); instead of using the sparking lengths he measured the secondary current with an electrodynamometer and instead of varying the primary current he varied the resistance in the secondary circuits.

INDUCTION COILS. Gooding. "Amer. Elec.," June.—He considers that the iron core of induction coils should be at least 40 per cent. longer than the secondary winding; by using such a core he increased the length of spark of a coil from 1½ to 3 inches.

TESTING SET BATTERY. Hobart. "Amer. Elec.," June.—For ordinary testing plain cells of zinc and carbon separated with blotting paper wet with common sal ammoniac will work very well; cells which will run quite steadily without polarization are made of two thin carbon plates separated by a layer of finely pulverized oxide of manganese, then wrapped in blotting paper and a zinc element added.

OHM'S LAW. Wilson. "Amer. Elec.," June.—A note describing the following method for using Ohm's law, and which involves remembering only the simple formula written E in the enumerator and C × R in the denominator. The value of any one of these quantities in terms of the other two is then found by placing the finger over the one whose value is desired; thus, covering E gives C × R.

ELECTRICAL ALLOYS. Appleyard. "El'ty," June 1.—A reprint, with the curves, of the article noticed in the "Digest" May 14 and 28.

METER TESTING. Sterling. "Amer. Elec.," June.—Instructions are given for the testing of alternating current meters, and for designing the testing rack.

Telegraphy, Telephony and Signals.

CUTTING CABLES. Holland. Lond. "Elec.," "Elec. Rev.," and "Elec. Eng.," May 27.—A reprint of a recent letter to the London "Times," which is endorsed editorially in the former journal. He argues that a belligerent should be allowed to cut a cable within the territorial waters of his enemy, even though the cable may be neutral property, terminating in the enemy's territory, and that the belligerent is subject only to a liability to indemnify the neutral owners. The cutting elsewhere than in the enemy's waters of a cable connecting the enemy with neutral territory receives no countenance from international law; still less permissible would be the cutting of a cable connecting two neutral ports, although messages useful to the enemy are being transmitted through it.

CABLE FLEETS OF THE WORLD.—"Zeit. füer Elek.," May 15.—A reprint of a table from the Electrician's Directory and Hand Book, giving tabulated data.

AUTOMATIC TELEPHONE EXCHANGE.—Lond. "Elec. Rev.," May 20.—An illustrated description of the system, a brief description of which was referred to in the "Digest" June 4; the present description is longer and contains more illustrations.

AMERICAN TELEPHONE PRACTICE. Miller. "Amer. Elec.," June.—The express system, such as used in a large exchange in San Francisco, is described in detail. The writer states that the feature of the elaborate system of signalling used with this system is that each signal is automatically given, without the volition of the operator or subscriber, being brought about by some action necessary in the actual connection or disconnection. In order to reduce the work of the operators to the last degree, two phonographs are placed in connection with the exchange, one of which constantly repeats the sentence, "Busy; please call again," and the other the sentence, "Subscriber called for does not reply."

RESISTANCE OF TELEPHONE INDUCTION COILS.—van Deth. "Amer. Elec.," June.—For the primary, 180 turns in two layers of No. 20 or 21 is recommended; some manufacturers make secondary coils with from 750 to 1000 ohms resistance, but he considers that they do not give as good results as 500 to 250 ohm coils; he found that on most lines when bridging bells are used, coils with a resistance of 50 to 75 ohms are better than those with high resistance secondaries, the line having a resistance of less than 2000 ohms.

COMBINED OPERATION OF TELEPHONE AND LIGHTING STATIONS. Clausen. "West. Elec.," June 4.—In towns of less than 20,000 inhabitants he believes it is profitable for the telephone and the lighting systems to be under one management, and he describes how this may be done.

TELEPHONE EXCHANGE APPARATUS.—"Elec. Rev.," June 1.—An illustrated description of the Sterling apparatus.

SUBMARINE CABLES.—"Elec. Rev.," June 8.—An anonymous article giving brief, popular descriptions of the leading cables of the world.

SPACE TELEGRAPHY. Thompson. "Eng. Mag.," June.—A brief abstract of his recent lecture in London, which has already been noticed.

ELECTRIC SIGNS AND SIGNALS.—"Sc. Am.," June 4.—An illustrated description of the Crandall system, in which letters are

formed in incandescent lamps operated by a keyboard; other brief descriptions have already been referred to.

ELECTRIC ALARM ATTACHMENT FOR CLOCKS. Belmont. "Amer. Elec.," June.—Working drawings are given, showing the construction of an electric alarm which may be attached to any clock at trifling expense, and made of materials which the average electrician usually has at hand.

Miscellaneous.

ELECTRIC FISHES. Knight. "Yale Scientific Mo."; reprinted in the "Elec. Rev.," June 1.—A short article on fishes which have the property of generating electric discharges. He refers to a careful study which has lately been made of the organs of these fishes; there are about fifty species possessing such organs, but only three are of particular interest; these are the torpedo, belonging to the skate family and occurring in the Bay of Biscay and the Mediterranean; the gymnotus or electric eel, found in the Orinoco, and the malapterurus or thunderer-fish, found in the Nile and other African rivers. The generation of the discharge and its intensity are under the control of the animal; the charge is developed by some chemical process occurring in the plate in which the electric nerve filaments end; in the gymnotus the posterior surface of the plate is negative, and the discharge is from the tail to the head, while in the thunderer it is in the reverse direction; for a full sized gymnotus the voltage is probably between 300 and 800; this fish gives the strongest shocks of all the species, and the discharge is capable of stunning a man; they use this power to protect themselves and to obtain food; the momentary currents are sufficient to deflect a galvanometer or to magnetize a needle; an interesting feature is that these batteries are constructed without any insulating materials, and the fish itself is apparently not affected by the discharge which it gives. The energy of the discharge is said to be developed on a much more economical plan than any yet devised by man.

RUBBER SUBSTITUTE.—"Ind. Rub. World," June 1.—A note stating that according to advices from Chicago a new substitute has been discovered in the form of oil derived from corn, which is vulcanized with an equal quantity of crude india rubber; this "corn rubber" is claimed to possess all the essential qualities of Para rubber (whether the electrical properties are included is not stated), and the cost is greatly reduced, 10 to 12 cents per pound being the price stated.

EFFICIENCY OF ELECTRIC HEATING APPARATUS. Rice. "Amer. Elec.," June.—Curves of efficiency obtained in a practical test of two electric heaters in raising the temperature of a small room showed that the number of watts to raise the temperature to any given amount was much greater with one heater than with the other; also that the maximum temperature possible for a given number of watts was greater with one than with the other heater; he asks, "Where does the extra heat go in the less efficient heater?"

GOVERNMENTAL DEPARTMENT OF SCIENCE. Gore. "Sc. Am. Sup.," June 4.—An article discussing the question of the advisability of consolidating all the scientific work of the Government into one Department of Science. If such a consolidation is practical he doubts whether the results would be enhanced.

AN ELECTRICAL BUREAU. Brophy. "Sc. Am. Sup.," June 4.—A reprint of a long address to building inspectors made last September. He discusses the question whether cities with a population of 75,000 or over should organize an electrical bureau for the better protection of life and property; he is decidedly in favor of it, and shows why such bureaus should be established.

ELECTRICAL APPARATUS FOR AMUSEMENT. Hopkins. "Amer. Elec." June.—Instructions are given for the construction of an electrical slate for giving an exhibition of spirit chirography. Within the slate is concealed resistance wire, the heat from which brings out the writing on chemically prepared paper.

ELECTRICAL PERIODICALS. Caldwell. "Amer. Elec.," June.—A table is given of all American elctrical journals known to the writer which have been published in this country and no longer exist. The table includes twenty-six titles, and a supplementary list is given of eight journals, of which but a few copies were published. The date of the earliest journal is October, 1852, the name being "The American Telegraph Magazine." Other telegraphic journals published prior to 1865 were "The National Telegraph Review," "Shaffner's Telegraph Companion," and "The Telegrapher."

New Series Governing Board.

Messrs. Sheehan & Hewitt, of Newburgh, N. Y., are meeting with great success with their new series governing board. This switchboard, as shown in the accompanying cut, is simple in construction, and will control any number of incandescent lamps in a series circuit where the circuit is fed from an alternating current dynamo, running at 1000 or 2000 volts or even a higher voltage. Central stations which are operating series lamps for street lighting will find this device a very valuable addition to their equipment, owing to its extreme flexibility, efficiency and simplicity. By the use of this governing board on a series of, say, twenty-volt lamps, across the 1000-volt mains, it is possible to burn any number of lamps, from one to seventy, by one lamp steps, and this control may be exercised by simply a change in the combination of the plugs on the series board. Any variation of voltage on this line in no way interferes with any other line on the same machine. The device, it is stated, consumes energy in direct proportion to the number of lamps burning. In other words, seventy lamps can be operated on a circuit with practically the same efficiency per lamp as with fifty lamps. Or twenty lamps on a circuit with practically the same efficiency per lamp as though fifty lamps were burning. The advantage, too, of being able to vary the voltage either up or down, on one series circuit, regardless of the voltage of the dynamo, enables the station attendant to carry one circuit which is feeding over a long distance 200 or 400 (as the conditions might require) volts higher than normal, or he may run a shorter circuit, or one which is feeding lamps near the station at as much lower voltage as he desires, thereby maintaining an even distribution of voltage over wide variation of service. Meesrs. Sheehan & Hewitt do not confine themselves to 1000 and 2000 volt circuits with this governing board, but make special boards to operate series systems, covering a wider range of voltage and meeting the conditions which exist in stations which have been operating series lamps for some years.

New Form of Primary Battery.

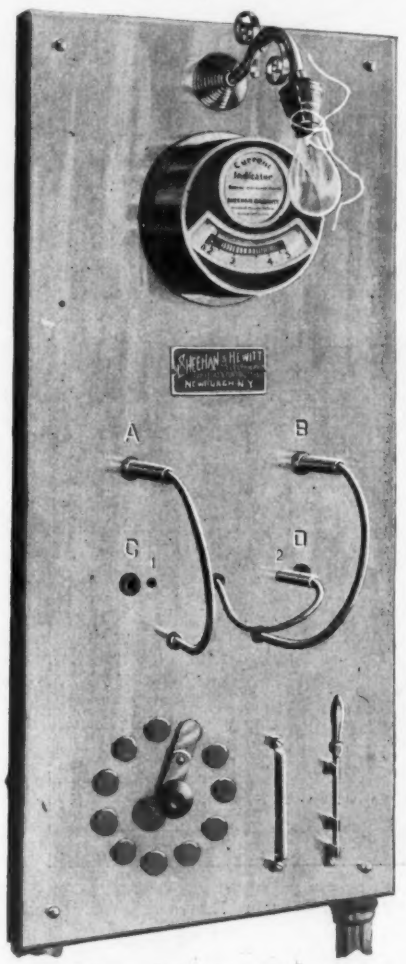
A primary battery of novel design has been recently patented by Mr. Nathan B. Stubblefield, Murray, Ky.

The elements of this cell consist of a bare iron wire and an insulated copper wire wound helically on an iron core, as shown in the accompanying illustration. This form, it is claimed, greatly increases the output of the couple, while at the same time a magnetic field of sufficient intensity to operate a solenoid or secondary coil is produced. The electrolyte may be water or moisture.

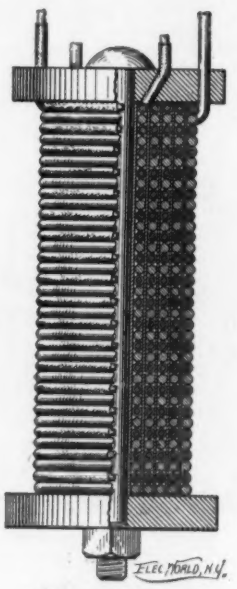
Mr. Stubblefield states that he has found that by this method of disposing the copper and iron wires as the elements he has obtained sufficient inductive effect in a secondary coil for practical atilization. The combined elements, it will be noticed, practically constitute an electromagnet. Mr. Stubblefield claims that the mere moistening of the coil will produce a difference of potential between the electrodes. The secondary coil is wound around the primary in the usual way, and the cell may be used as a self-generating electromagnet, by properly connecting the wire terminals and wetting or dampening the coil body.

The inventor claims that this cell is suitable for telephone and telegraph purposes, and is especially valuable in electrotherapeutics. It is also applicable to bells, annunciators, etc. For such uses it is proposed to place the battery in moist earth.

Messrs. Stubblefield & Love, Murray, Ky., are exploiting this novel cell.



SERIES GOVERNING BOARD.



A NOVEL PRIMARY BATTERY.

Twentieth Century Incandescent Lamps.

The construction of the lamp illustrated herewith differs somewhat from standard methods, and one of the most notable departures is the absence of plaster in securing the bulb to the lamp base. This is accomplished by spring-

ing a collar over a projecting ring or swelling on the globe, and when the cap or base is set over this, the ring or collar is permanently locked, and, it is claimed, can never work loose. In the collar there is a nick which corresponds to an indentation in the glass neck, thus preventing turning in the base.

The absence of such material as plaster around the leading-in wires prevents the absorption of moisture and avoids electrolytic action between the wires, which action results in corrosion of the wires or short circuiting of the lamps, especially when the lamps are used on signs or in damp places.

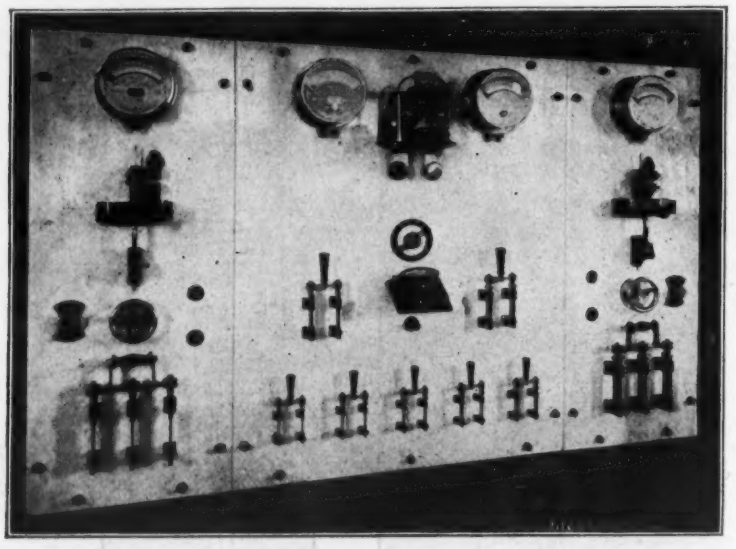
Supply houses, it is stated, will find this lamp desirable because they can supply all voltages in odd bases, on short notice, carrying a limited number of

Twentieth Century Lamp.

unmounted globes and fitting them on to the bases to order. Standard bases and voltages are shipped already mounted. Cellulose filaments are used in these lamps. The lamps have good vacuum and high efficiency, and are uniform in quality. They have already earned a reputation, and are manufactured by Mr. George M. De Ginther, Eleventh and Walnut Streets, Philadelphia, Pa.

An Isolated Switchboard.

The switchboard shown in the accompanying illustration is one of the new types manufactured by the Linton Manufactured Company, of Worcester,



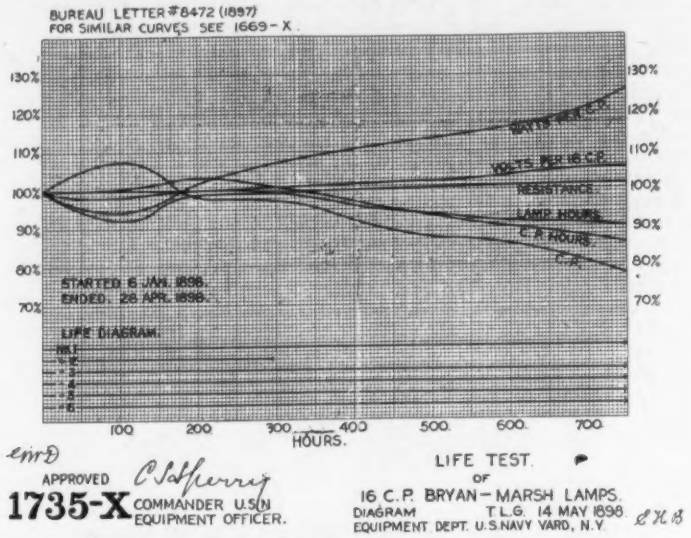
Switchboard in the Converse Building, Boston.

Mass., and is installed in the new Converse Building, Boston. It is claimed to be as fine a specimen of workmanship as can be seen in any isolated plant in New England. It is composed of three panels of white Italian marble, two of the panels being for the generator and one for the feeder switches. The elaborate system of fusing the switches on the back of the board has attracted the particular attention of engineers and contractors, owing to the free access to the fuses at all times, and at the same time obviating all possible risks of fire.

Incandescent Lamp Testing at the Brooklyn Navy Yard.

The tests made by the Brooklyn Navy Yard on incandescent lamps are carried out in a more thorough manner than by any other consumer. The reputation of the Navy in the matter of tests is well known. The approval of the navy yard is a mark of excellence, whether it be applied to a piece of soap or an armor plate, and the incandescent lamps purchased for the navy are tested with an amount of care which makes their determinations of interest to the whole electrical fraternity.

The racks on which the lamps are tested are fastened against the wall so that the lamps project therefrom in a horizontal position. Before the lamps to be tested are placed upon these racks, they are carefully inspected to see that all exposed portions are protected so that moisture cannot gain access to the plaster of paris and all holes are carefully plugged. The bases are of a given length, as also are the bulbs. The dimensions of the lamps complete must not exceed fixed limits. The storage batteries are connected with the testing racks through several feeders tapped in along their length so that the voltage can be exactly maintained on every lamp upon every rack. There is in series with these batteries a rheostat, with a Holtzer-Cabot automatic regulator attached



Report of Lamp Tests by Navy Department.

thereto by means of which the voltage on this feeder system is maintained almost absolutely constant throughout the life test. The arrangements are most complete, and tests are entirely comparable one with the other, as they are all made at constant voltage and in comparison with standard lamps, which are checked and maintained with all the accuracy to be expected from a plant of this description. The advantages of testing at absolutely constant potential are beyond dispute. They admit comparisons which are good for all time, as conditions are known and the results absolute. The largest stations and testing bureaus are fully aware of the advantages of testing lamps at constant potential, but nowhere is the installation for doing this any more complete than at the Brooklyn Navy Yard.

The labor of the testing bureau is as complete in its analysis of these results as are the methods for obtaining them. The complete readings of voltage (this would seem almost unnecessary) current and candle power are made at regular 100-hour intervals, and the lamps maintained on test until they have fallen to 80 per cent of their initial candles, which candle power is assumed to be that at which their value to the department has ceased. As an illustration of the care which the Navy Department takes in analyzing its tests there is shown herewith a facsimile of such a report. It will be noted by reference thereto that the change in watts per candle, the change in volts per sixteen candles, the change in resistance, the lamp hours, candle-power hours, and change in candles are all faithfully plotted. The navy, of course, is intensely mathematic, and the logarithmic tables, slide rules and other accessories to a mathematical workshop are everywhere evidenced.

The bureau of equipment has a lively appreciation of the equivalent life and candle-power performance of incandescent lamps at varying percentage increase or decrease in voltage, which is possessed by few central stations or isolated plant managers or engineers.

The following table will serve to illustrate what these changes which the department is so anxious to avoid really are:

TABLE SHOWING COMPARATIVE LIFE OF LAMPS.

	Initial C. P.	Initial Watts per C. P.	Total Watts.	Hours Life.
Normal voltage.....	16	3.50	56	1000
1 per cent. high.....	16.9	3.38	57.12	800
2 per cent. high.....	17.9	3.26	58.35	650
3 per cent. high.....	18.9	3.15	59.53	550
4 per cent. high.....	19.9	3.04	60.49	450
5 per cent. high.....	21.2	2.93	62.11	350

It should be remembered that lamps so burned at excessive voltage rapidly deteriorate in candle power, with consequent increase in watts per candle.

TABLE SHOWING COMPARATIVE LIFE OF LAMPS BURNED BELOW THEIR RATED VOLTAGE.

	Initial C. P.	Initial Watts per C. P.	Total Watts.	Hours Life.
Normal voltage.....	16	3.50	56	1000
1 per cent. low.....	15.1	3.63	54.81	1250
2 per cent. low.....	14.2	3.77	53.53	1500
3 per cent. low.....	13.2	3.92	52.52	2000
4 per cent. low.....	12.6	4.07	51.28	2500
5 per cent. low.....	11.8	4.24	50.03	3000

One criticism of the tests described is that they have not appreciated quite so clearly as they should the necessity of securing readings on the ascending

candles and attendant decreasing watts per candle during the few hours at the beginning of the test. It will be noticed that the first portion of all the curves of candle, watts per candle, etc., are marked with a little indefiniteness and indistinctness. This, however, is but a minor criticism.

Central station men and others would do well to examine this very complete installation, as, by following similar construction, they could procure testing facilities which would help to place lamp manufacture, selection and operation upon a higher scientific plane.

Exhibits at the Philadelphia Electrical Exhibition.

The Philadelphia Electrical Exhibition was opened on June 6, with appropriate ceremonies. There is in constant attendance a corps of gentlemen, each one wearing a badge, indicating that he is at the service of the general public to guide the visitors around the exhibition and give them all the information desired regarding the same, describing the various electrical exhibits, etc. There is quite a long list of exhibitors, among them being the following:

MR. D. A. BAKER, 1033 Race Street, Philadelphia, makes an exhibit of electric signs.

DR. MARCUS ROTHSCHILD, Bourse Building, Philadelphia, exhibits his electrical power lens grinding apparatus.

MR. GEORGE M. DE GINTHER, Eleventh and Walnut Streets, Philadelphia, is represented by a line of holophanes.

MR. J. H. WILDAY, 23 Duane Street, New York, has an exhibit of his electric engraving machine in practical operation.

MR. THOMAS A. EDISON, Orange, N. J., exhibits a model of his magnetic ore separator, which is in continuous operation.

MR. W. P. DALLETT, 39 North Seventh Street, Philadelphia, has a Deming electric pump, operated by an Excelsior motor.

THE HELIOS ELECTRIC COMPANY, 1229 Callowhill Street, Philadelphia, has an exhibit of sixty-one enclosed incandescent arc lamps.

THE BURTON ELECTRIC WELDING WATER FORGE is exhibited by Hawthorne & Sheble, 604 Chestnut Street, Philadelphia, Pa.

THE STANDARD FIREPROOFING COMPANY, Perth Amboy, N. J., makes an exhibit of its earthenware conduits and fireproofing.

THE SPRAGUE ELECTRIC COMPANY, New York City, is represented by a line of Lundell fans and motors and a Lundell organ motor outfit.

H. R. WORTHINGTON, 724 Arch Street, Philadelphia, makes a display of electric house tank pumps and electric pumps for elevator and general service.

THE KEYSTONE ENGINE & MACHINE WORKS, Fifth and Buttonwood Streets, Philadelphia, exhibits a model of the Buckeye engine, with sections exposed.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., occupy a booth, and the system of instruction is explained by representatives to those interested.

MR. ALFRED F. MOORE, 200 North Third Street, Philadelphia, makes an attractive display of a full line of insulated wires for all purposes, lamp cords, telephone switchboard cord, rubber covered line wire, etc.

THE MOORE VACUUM TUBE Turkish smoking room is one of the popular attractions. The current for the operation of the vacuum tubes is taken from the street mains of the Edison Electric Light Company, of Philadelphia.

SAWYER ELECTRICAL COMPANY, 1308 Arch Street, Philadelphia, makes a display of Nowotny enclosed arc lamps, Faries lamp fixtures, a Triumph Electric Company 7½-hp motor, Sawyer elevator door locking devices, telephones, etc.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., makes a display of Thomson electric meters for two and three wire systems, direct and alternating currents, Thomson-Houston alternating fans, and Thomson-Houston alternating arc lamps.

THE AMERICAN FEATHER FLOWER COMPANY, 144 North Seventh Street, Philadelphia, has a unique exhibit. It consists of a showcase in which are displayed feather flowers, and an exhibit of the manufacture of feather flowers, with decorative lamps inserted.

MESSRS. VALLEE BROTHERS & CO., 625 Arch Street, Philadelphia, have an attractive exhibit of electric heating apparatus and Whitney voltmeters, Zimdars & Hunt panel feeder boards and knife switches, Victor lamps, miniature lamps, Paragon desk fans and Diehl ceiling fans.

MESSRS. WILLIAMS, BROWN & EARLE, 918 Chestnut Street, Philadelphia, have an exhibit of an electrical centrifuge and a line of electrotherapeutic apparatus, including an electrogalvanic controller, Dr. Massey's electric controller, Dr. Massey's galvanic cancer battery and the electric cautery controller.

THE EDISON DECORATIVE & MINIATURE LAMP DEPARTMENT, Harrison, N. J., has a scattered exhibit of its products. One design represents a moving windmill, illuminated by 400 miniature lamps. An American eagle and illuminated shield also constitute attractive features of the exhibit on the first floor.

MESSRS. WALKER & KEPLER, 531 Chestnut Street, Philadelphia, exhibit a line of Lundell dynamos and motors, telephone apparatus, heating apparatus, switchboard instruments, bell and gas lighting supplies, iron armored conduit and fittings, pole line material, Pioneer arc lamps, Imperial incandescent lamps, gas, electric and combination fixtures and shades, etc.

THE UNITED ELECTRIC IMPROVEMENT COMPANY, Nineteenth Street and Allegheny Avenue, Philadelphia, makes a display of a long line of electrical apparatus. This company is a manufacturer of direct current dynamos and motors, alternating current apparatus, switchboards, etc. It makes a feature of rewinding armatures, also general electrical repair work.

THE AMERICAN ELECTRIC METER COMPANY, Ninth Street and Montgomery Avenue, Philadelphia, makes a display of three-wire meters, direct current in series for 10, 20 and 40 amperes, showing three meters of each capacity. In connection with the 10-ampere meters is shown a lamp bank for the same. Other features of the exhibit consist of a giant magnet and apparatus for testing the strength of the same by means of armatures, and a glass surface and cases for exhibits of magnetic fields.

MESSRS. OTIS BROTHERS & CO., New York City, are represented by the Stokes & Parrish Elevator Company, 702 Bullitt Building, Philadelphia, which has an exhibit of an elevator, with automatic push button operating devices. The Stokes & Parrish Company also exhibits a working model of an electric hydraulic elevator designed and constructed by D. W. C. Suplee, Glenolden, Pa.

THE EDISON ELECTRIC LIGHT COMPANY, Philadelphia, makes an extensive and varied exhibit of electrical apparatus, including a printing press operated by an electric motor, a screw cutting lathe driven in the same manner, both in practical operation; desk fans, ceiling fans, wattmeters, a bank of forty lamps, decorative lamps of all styles, desk reflectors, electric curling irons and other electric heating apparatus.

MR. RUDOLPH M. HUNTER, 926 Walnut Street, Philadelphia, makes an exhibit of his various inventions, etc. It includes a model of his third-rail electric railway system, one-twentieth full size; a series multiple car conductor, a working model of a modern electric car truck with the motors hinged to axles; one of Mr. Hunter's early trolleys; a large searchlight of special design, said to be the largest made in this country; a searchlight having horizontal carbon and reflector, invented in 1881; a method of regulation without resistances; a miniature alternating transformer system illustrating method of operation in large plants for local and long-distance transmission, such as in use at Niagara Falls; electric switches, meters and a series of volumes, photographs, etc., relating to Mr. Hunter's inventions.

MESSRS. MORSE, WILLIAMS & CO., 1105 Frankford Avenue, Philadelphia, show a large sized, direct connected, winding drum electric elevator, with attached motor and variable speed controller. This elevator is designed for a travel of 350 feet per minute for passenger service or 10,000 pounds at slow speed for freight service. A small-size factory belt ceiling machine, driven by reversible motor and single belt with motor and controller arranged to illustrate the usual manner of erection and operation in factory, is also shown. Beside these are exhibited a model of a direct connected electric passenger elevator suitable for residence service and adapted for automatic push-button control, and a model of the Hindley worm and wheel, which is used by the firm in all its direct connected and belt-driven hoists.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has an exhibit of one of its engine-type multipolar generators. One of the noticeable features of this machine is that the field casting is divided vertically and set upon ways, thus affording facility for immediate inspection and removal of the armature or any coils of the armature and field. The entire armature is carried by an iron spider, is pressed and keyed upon the extended engine shaft and may be drawn off whenever necessary without in any way interfering with the permanent arrangement of the commutator and windings. A Westinghouse gas engine is also shown in this exhibit. The valve actuating mechanism is located inside the crank case, where it is protected from dirt and grit, and where it is constantly and copiously lubricated. The valves are of the poppet type positively actuated, and have no moving surfaces to wear or cut. To insure good regulation this engine is built with two cylinders, giving an impulse at every revolution. It regulates for changes of load by varying the amount of explosive mixture delivered at a charge, but it receives an impulse at every revolution whether running fully loaded or entirely light. A Tesla alternating current polyphase motor also forms a conspicuous object in the Westinghouse exhibit. The revolving element of this motor, as is well known, is of the "squirrel-cage" type. The motor may be placed in any position, on the floor, wall or ceiling, provided the shaft is horizontal, and may be controlled from any convenient point.

A New Electric Light Photometer.

A subject of interest, alike to lamp manufacturers and station superintendents, is the rapid and accurate measurement of the candle-power of incandescent lamps. The desideratum in all physical measurements is accuracy, and, in so far as securing it does not entail other undesirable features, the value of a measurement is proportioned to its accuracy. In commercial testing, however, the primary object is to effect a saving in expense, and in accomplishing this, that most expensive element—time—enters as a predominant factor. It is essential, therefore, that the method pursued be expeditious. This explains why it is that the apparatus usually employed for photometric measurement is unsuited to the purpose. The cheaper photometers are inaccurate; the high-grade ones have a defect quite as serious, since they do not lend themselves to rapid work, even of an approximate nature. Unquestionably the central station would make many more measurements of candle-power, efficiency and life, if it could be done without undue expenditure of time and energy.

With their requirements in view a series of experiments have been made, extending over a considerable period, to determine upon a construction best suited to their work. A brief consideration of the objects to be attained and the best methods of securing them may not be without interest.

Essentially a photometer consists of a standard of light, a support for the lamp under test, a graduated bar, and a photometer screen. These elements should be chosen with care. The present standards are: The standard candle, the Methven screen, and the amyl acetate lamp. In this country they are in reality all referred for their values to the standard candle, but from considerations of accuracy and convenience the amyl acetate lamp more often finds practical use. All, however, are reliable only when used by experienced operators under favorable conditions. Comparisons with them consume much time, and results of value are gotten only by taking the average of a series of readings.

There is needed, therefore, a standard suitable for practical work every day. Experience has shown that incandescent lamps, properly treated and used with precaution, will maintain a constant candle-power for an extended period. They are eminently suited to the work, as they have, if suitably rated, practically

the same candle power and color as the lamp under test—conditions that conduce to accuracy and rapidity. These lamps have to be accurately standardized by comparison with the ultimate standard of light, and to do this necessitates the use of a photometer suited to compare lights of unequal intensity and different colors. Happily for the central stations, standard incandescent lamps may now be secured with their values properly determined and certified to.

The precaution to take in using these standards is to subject them to no higher potential than that for which they are rated, and to maintain it strictly at that potential when using them. The usual 16-cp, 110-volt standard has a resistance of about 200 ohms. Owing to different pressures at the stations, it is necessary to take care of about 10 per cent. variation in the pressure, and to do this will require a rheostat in series with the lamp of about 20 ohms. A change in this capacity lamp of one-half of 1 per cent. in the candle power will be produced by a variation in the current of one-tenth of 1 per cent. To maintain the current to within this figure necessitates about .2 ohm steps, or 200 steps in all. This can be secured in a proper form of rheostat. It is then possible to maintain the value of the standard within practical limits.

Secondary incandescent lamp standards should always be secured in pairs, so that they may be checked one against the other should the accuracy at any time be in question. In the daily measurements of numerous lamps the standard should not be used. It is intended only to check up a lamp that will be temporarily used for the day. By making this check once or twice a day the working standard will be readily kept right and without lengthy use of the standards proper. In this manner the latter will last for a long period.

Another important consideration is the nature of the support for the test lamp. Experience has shown that the only way to get satisfaction through a large batch of lamps is to use a rotating socket. Throughout a horizontal plane the candle power varies markedly and occasionally erratically. To be sure, with a particular make of lamp a relation might be established between the mean candle power and that in some particular direction. A measurement of the latter would then determine the former, but careful setting of the lamp would be required. This method, moreover, would not permit comparisons of different makes and sizes. In such cases numerous readings would need be taken and averaged.

With a rotating socket, however, the difficulties are satisfactorily met from the fact that the mean candle power is at once determined from a single reading. All calculations and the incidental opportunity for mistakes are avoided, and the measurement gives at once a value that permits of comparison with any other lamp.

The next prominent feature in a photometer is the optical screen for presenting to the eye an indication as to relative values of the lights. Two forms are in use in this country—the Bunsen and the Lummer-Brodhun. Without going into details of construction, it will be sufficient to point out the advantages and the disadvantages of the two forms.

The Lummer-Brodhun screen is by far the most sensitive form at present made. Particularly is this apparent when one attempts to compare lights of different color and intensity. It is, therefore, best suited to standardize incandescent lamps by comparison with standard candles or the amyl acetate lamp. Unfortunately, on the other hand, it is somewhat tiresome to use, and for that reason not to be recommended when continuous work is to be undertaken.

The Bunsen screen, however, though not so sensitive, is much more quickly read and without fatigue to the operator. When, therefore, only incandescent lamp standards are used, this screen is preferable to the more sensitive form.

Finally, we must have a graduated scale for determining the position of the screen when balance is obtained. On some instruments a scale is employed graduated to millimetres, but this is only desirable where the distance between lights is to be varied, as it entails considerable calculation. The usual bar is graduated by inverse squares in such a manner as to show by inspection the relation between the lights under comparison. A more satisfactory arrangement, however, is to graduate for a standard of particular value, and thus make it read directly in candle power.

A photometer constructed on these lines meets perfectly the demands of the lighting station, enabling several thousand lamps to be tested per day and doing the work with a high degree of accuracy.

The firm of Queen & Co., Philadelphia, Pa., has placed on the market a new photometer, illustrated below. As will be noticed, it is a departure from the usual design. Cast-iron pedestals support the metal photometer bar and carry stages for the support of the lights, screens, etc. The rheostat shown on the left-hand pedestal is for the control of the potential on the standard. It is about 800 or 1000 steps, and permits of perfect adjustment. A similar rheostat on the right regulates the current on the test lamp. The graduated bar is inclined at an angle of 45 degrees, in which position the graduations are lighted by the lamp under test.

Electric Light Photometer of New Design.

The screen, which may be of either the Bunsen or Lummer-Brodhun type, is mounted on a truck, and may be rolled along the bar wherever desired. A milled-head permits of close adjustment when balance is nearly attained. The instrument is complete in every respect, and the result of several years' experience with photometric apparatus.

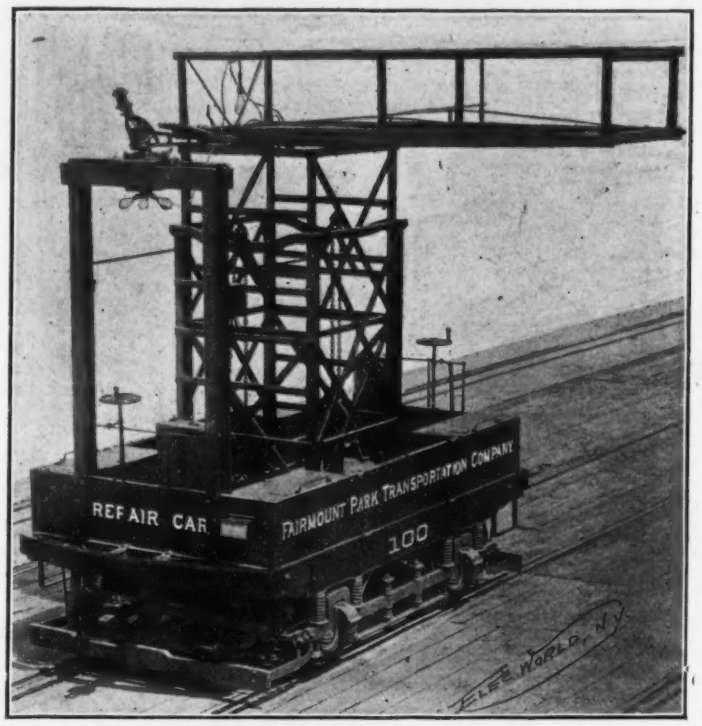
Tower Car for Electric Railway Construction.

The electric railroad in Fairmount Park, Philadelphia, Pa., it is stated, presented more novel problems than any other trolley road which has been built during the last ten years. In putting up the overhead work one of these was encountered. The line of the road was in deep ravines, over trestles and along embankments. There was no highway along any part of the road upon which the familiar trolley tower wagon could be operated, even when the track was on a level with the ground. On the bridges and trestles the ordinary wagon was out of the question. Speed of construction was necessary, and as the company had to transport materials over its own line for long distances, the work of construction was not unlike that of some steam roads in the wilderness. The questions involved in putting up the overhead work were presented to the J. G. Brill Company, and its answer was a design for a tower car. The design was approved by the Fairmount Park Transportation Company, and from it was built the tower car shown in the illustration. The locomotive part of the car consists of a four-wheeled truck with solid forged side frames (Brill No. 7), 33-inch wheels, and two W. P. 50 motors. The gauge of track is that used in the city of Philadelphia, 5 feet 2¼ inches; the wheel base is 6 feet. Eight journal springs carried on ears from the boxes support the frame of the truck. The body of the car is caused by eight large spiral springs resting on the frame.

On the truck is placed a short, very strong and solid body. This is 12 feet

over the end sills and 6 feet 10 inches wide. The sills are about 9 inches deep and are framed so as to give a strong support to the angle iron buffers. The sides are 18 inches high by 1¾ inches thick. They are strapped and made very solid. A short length in the centre of the side is made to drop.

At one end there is a trolley stand on a separate frame which is braced from the tower. This stand carries four incandescent lights. In the same circuit there is a movable light with long leads, so that it can be used at the extreme end of the platform or at any other point about the car where a light may be needed. In each corner of the body there are tool boxes built in. The tower and platform was supplied by Messrs. McCardell & West.



REPAIR CAR FOR THE FAIRMOUNT PARK ELECTRIC RAILWAY.

The platform has a 9-foot reach, and is placed in the middle of the car. The wide wheel base made this easily possible. The reach of the platform had to be great enough to cover the opposite track. There are brake wheels at both ends of the car, two controllers, two gongs, and the usual sand boxes are provided. The total weight complete is 15,000 pounds. The car was found very useful and did its peculiar work in a perfectly satisfactory manner.

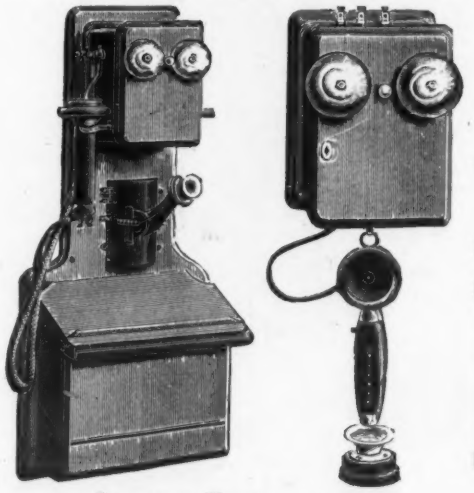
Improved Telephones.

The Maryland Telephone Manufacturing Company, Baltimore, Md., is manufacturing several types of telephones, such as desk sets, interior and intercommunicating sets, etc., in all of which the Brown "loud-speaking" transmitter is used.

The Minnis system of telephones and switchboards is one of the specialties of this company. This system was first installed in Mobile, Ala., in the summer of 1895, where it is still in operation. Since then it has been installed in Sing Sing, N. Y. It is a common return common battery system, using the type of telephone illustrated herewith, and constructed on the common return principle, without ground connections at any point. Some of the advantages claimed for this system are that under it the common return system can be used without surrendering any of the advantages gained by the use of all metallic circuits, thus saving 50 per cent. on the cost of all outside construction, except wire, the saving on wire being about 35 per cent. A saving is also claimed by the elimination of the induction coil, the magneto generator and the battery in each telephone, four cells of storage battery furnishing the talking current to any number of subscribers. The size of the battery cell is increased in proportion to the increase in the number of telephones connected with the exchange. By the peculiar "polaric" method of connecting the batteries in their relation with the telephones and the switchboard all cross talk is, it is stated, prevented, and inductive disturbances reduced to a minimum.

The great advantage claimed for this system is the small size of instruments used, the receiver-transmitter being connected with the line by means of a flexible cord several feet in length and carried upon an automatic reel mechanism inside the small box, on which are mounted the bells. By means of this cord the talking, calling and switching devices of the telephone set can be removed to some distance from the wall box, thus making each instrument a desk as well as a wall set.

The factory of the company is at Nos. 11-13 East Lee Street, Baltimore, Md., and the New York sales office, No. 130 Fulton Street, is under the management of Mr. Paul Minnis.

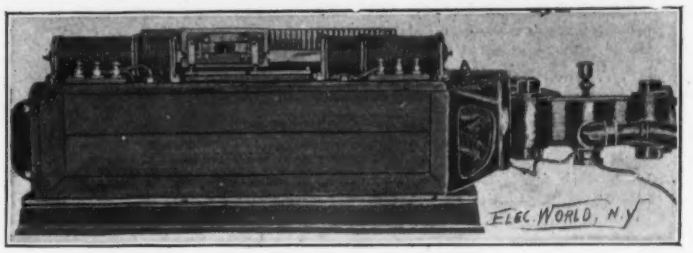


IMPROVED TELEPHONES.

A Novel Air Compressor Motor.

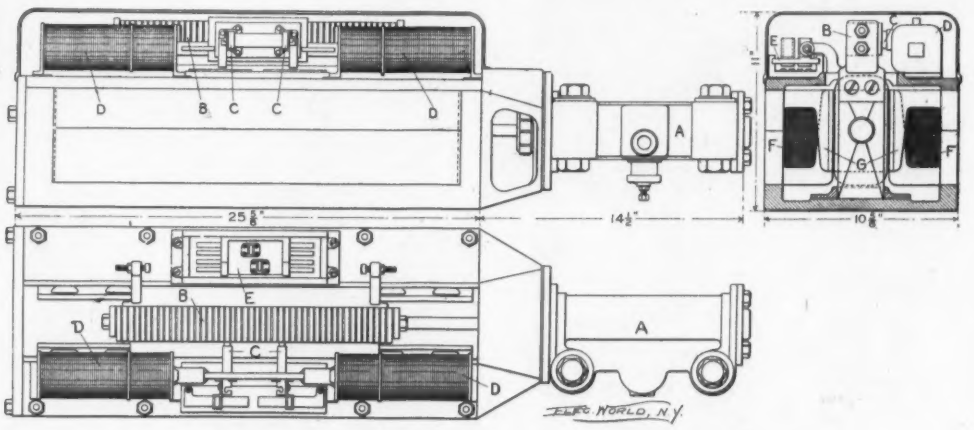
A reciprocating electric motor, suitable for any purpose for which a pure reciprocating motion is desirable, such as rock drills, etc., and particularly designed for compressing air for air brakes on electric cars, is in use on one of the cars of the Union Railway Company, of New York City. The peculiar features of the design are the inventions of Messrs. A. R. Roe and F. W. Merritt, the patents being controlled by the Electric Motor Company, of which Mr. D. H. Bates is the New York representative, with offices in the Wool Exchange Building.

The action of the air compressor is analogous with that of the direct acting Westinghouse steam compressors used so universally on steam roads, doing away with rotary motion and gears, and allowing the compressor to be conveniently placed beneath the seat of any ordinary street car. The machine shown on the car of the Union Railway is but 40 inches in length and 11 inches in width and height, and weighs altogether about 300 pounds. The cylinder is 3½ inches in diameter by 8½ inches stroke, and supplies a storage tank 14x36 inches in size, with a maximum pressure of 30 pounds and a minimum pressure of 20 pounds to the square inch, this giving enough air for the full application of the brake ten times before it becomes necessary for the motor to start up. In ordinary service the motor makes about 250 to 300 strokes per minute when running, and pumps the tank pressure up in about fifteen seconds, this occurring every four or five minutes. Tests made with a recording wattmeter are said to have shown that the motor delivers sufficient air for the application of the brake to the emergency position twenty times per hour, with an average consumption of 0.6 of one horse-power.



ELECTRIC AIR COMPRESSOR.

The construction of the motor is quite interesting, the machine being practically a multipolar motor with its armature, commutator and field magnet poles straightened out. There are eight poles on either side of the armature, which runs up and down between them, these sixteen poles being all excited by a single shunt field winding, the pole shoes being alternately brought up from opposite sides of the winding, somewhat as are the poles of a Walker alternating dynamo. Opposite pole faces are of the same polarity. Running between the faces of the poles and attached to the piston rod is the straight armature with 36 armature slots, suitably wound with a cross connected winding and connected up to forty-six commutator segments, the end segments being repeated. Two brushes are pressed against this armature at a distance from each other equal to the distance between poles. The brushes are attached to the plunger of another solenoid in such a way that they can be moved a distance equal to one pole length. When the current enters the commutator



PLAN, SIDE AND END ELEVATIONS OF ELECTRIC AIR COMPRESSOR.

through these brushes it sets up a polarization in the armature, which tends to drive it in one direction. When it reaches the limit of its motion in this direction it throws a switch which reverses the pull of the brush controlling solenoids. The brushes are thereby thrown lengthwise the distance of one pole of the fields, reversing the polarity of the armature and causing it to be drawn in the other direction. The cylinder is double acting and the motor works back and forth very smoothly. An automatic cut-out shuts off the current when the pressure rises to any predetermined limit, and turns it on again when the pressure falls below the other limit. To obtain quick action of this switch the cylinder operating it is supplied with air by a D valve, which is pneumatically controlled by a second D valve, which is forced one way by the air pressure and the other way by a spring.

To provide for the large variations of voltage occurring on street railway lines, a set of resistance is thrown in series with the armature and one or more of these are cut out automatically by magnets as the voltage falls.

Improved Types of Enclosed Arc Lamps.

The Manhattan General Construction Company, New York City, has developed some new and improved types of enclosed arc lamps which are designed to burn in multiple on direct-current circuits of from 90 to 250 volts; in series on circuits of from 200 to 600 volts, and on alternating-current circuits of any frequency, from 90 to 130 volts. These lamps contain all the features of the company's old lamp and combine many new and radical departures in design and construction. The length of the lamp (Fig. 1) has been reduced to 29 inches, and the outer globe is stationary on a fixture on the body of the lamp. This latter feature has been copied from the old lamp. In the new lamp there has been introduced the novel feature of lowering the bulb through the opening in the bottom of the outer globe on double telescoping rods, as shown in Fig. 2. The inner bulb and carbons are thus brought in full view below the lamp, and the trimming device, on being raised automatically, locks in position. The trimming device is lowered by merely pressing the knob on the bottom of the lamp. The current is fed to the upper carbon directly through the sheath in place of a separate brush box, as formerly. Contact between the sheath and inner tube is made through metal balls contained in the sheath. These balls are attracted against the sides of the inner tube by magnetism, and, it is stated, assure perfect contact. The cap of the inner bulb used in the new lamp is provided with a gas chamber, which, it is claimed, materially lengthens the life of the carbons. This cap is made under patents of L. B. Marks and Moses S. Okun, covering every form of cap having a gas chamber and lateral movement.

Adjustment of the rheostat may be made by loosening set screws and lowering the split canopy at the top, as shown at A in Fig. 4. The only moving part in the lamp is the armature, inside of which is a ball clutch. This clutch consists of four balls, which ride between the inclined surface of the inside of the armature and openings in the central brass tube. The armature and clutch may be removed from the lamp while it hangs in position by simply unscrewing one nut. A ventilated magnet has been provided in the new lamp, and a current of air constantly passes between the magnet and central tube, thus removing the heat and averting the danger of burning out the magnet.

The air chamber in the old type of lamp has been done away with in the new. In the new lamp there is no such chamber, a loose fit being maintained between all of the parts. Indeed, all of the parts are loose fits, and they may be entirely removed with ease. This greatly facilitates the proper assembling of the lamp. To remove the magnet the lamp may remain hanging in position. All that is necessary is to take off the clutch and frame and unscrew the cap F (Fig. 4). The armature may then be taken out, and then, by unscrewing the nut, D, and the central tube, C, the magnet, B, may be slipped out of the frame, A, and every part of the lamp become separate. In taking it apart no insulation of any kind is disturbed.

The improved electrical and mechanical design of the magnet and armature enables the lamp to burn within very narrow limits and with great steadiness.

The mechanism of the Manhattan lamp for 220 volts is precisely the same as that above described, and the lamp can be transferred from a 110-volt circuit to a 220-volt circuit by the substitution of another coil and rheostat and a change of the nut holding the armature. By a change of the magnet coil the lamps may be arranged to burn two or more in series on circuits of from 200 to 600 volts. A special form of separate rheostat is furnished with each lamp. By cutting this rheostat in it takes the place of a lamp when one lamp in the series is cut out, without disturbing the balance of the series.

The mechanism of the new type Manhattan alternating-enclosed arc lamp differs from that of the direct-current lamp, as shown in Fig. 3, the trimming device, outer globe, gas check plug, carbon sheath and shell being the same, however—these parts of the two lamps being interchangeable. The clutch is the same as that in the direct-current lamp, and the entire mechanism consists of a magnet and core, stationary central tube, containing the ball clutch, and a dash pot. All clockwork, toggle clutches, carbon rods, walking beams,

Fig. 1.

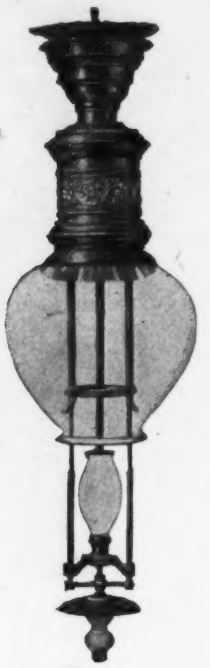


Fig. 2.

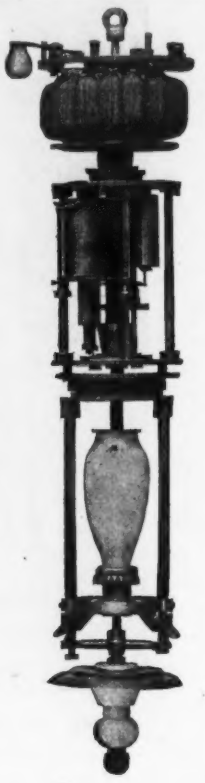


Fig. 3.

racks, levers, etc., have been eliminated. Access to the mechanism while the lamp is hanging in position is easily attained.

The Manhattan Company states that it has been working on this lamp for nearly a year, and has subjected it to continuous commercial tests. It is both economical and reliable, and starts up quickly and without chattering, no readjustment being necessary on a variation of from 100 to 130 volts. The lamp will burn 100 hours with one 9½ inch x ½ inch upper and one 6 x ½ inch lower carbon, the unburned portion of the upper being used as a lower for the next run. On circuits of 100 volts and 6 amperes the lamp consumes 450 watts.

The alternating lamp may be adjusted by a simple change of connections on the top plate for circuits of 7200 to 17,000 alternations, and has a range of adjustment for voltage of from 90 to 130 volts. The outer globe is suspended on a white enameled ring about 7½ inches in diameter, and, being directly over the arc, of course acts as a reflector and materially increases the efficiency of the light. One special feature in connection with this lamp is that the carbon sheath is removable.

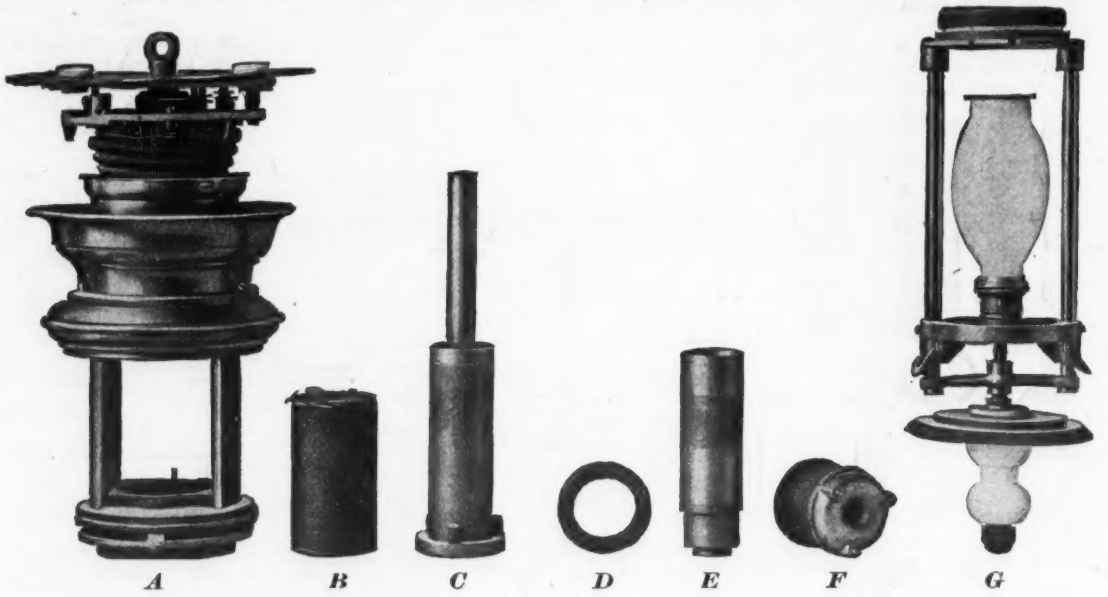
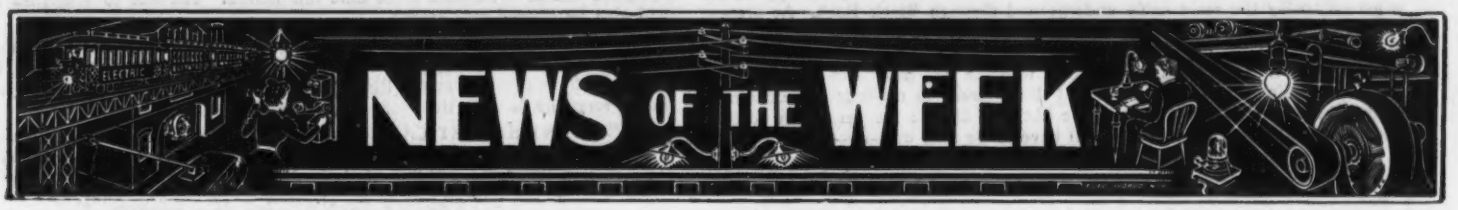


Fig. 4.



Financial Intelligence.

THE WESTERN UNION TELEGRAPH COMPANY has declared a regular quarterly dividend of 1¼ per cent.

THE COMMERCIAL CABLE COMPANY has declared a quarterly dividend of 1¾ per cent. on its capital stock, payable July 1, to holders of record June 20.

THE COLUMBUS STREET RAILWAY COMPANY reports gross earnings for May, $63,346, an increase of $14,456 as compared with the same month last year, and net earnings, $33,728, an increase of $7922.

THE NEW ORLEANS TRACTION COMPANY reports gross earnings for April of $109,065, an increase of $5075, as compared with the same month of last year, and net earnings, $44,713, an increase of $7533.

THE STOCKHOLDERS of the Edison Electric Illuminating Company of Brooklyn have authorized the directors to increase the capital stock from $4,000,000 to $5,000,000. The money, it is stated, is to be expended in extending the plant and purchasing the Municipal Electric Light Company.

THE DIRECTORS of the American Bell Telephone Company, according to the "Boston News Bureau," have voted to issue $5,000,000 4 per cent. ten-year debenture bonds, dated July 1, 1898. Two million dollars of this amount is to refund a like amount of 7 per cent. bonds falling due August 1, 1898, and the $3,000,000 is for the estimated new construction requirements.

Special Correspondence.

New York Notes.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, June 13, 1898.

THE WESTERN UNION TELEGRAPH COMPANY announces that its new cable between Port Townsend, Wash., and Victoria, B. C., has been laid and it can now accept telegrams for Victoria direct.

ELEVATED RAILWAY CARS ON THE BRIDGE.—It is reported that an agreement has been practically reached whereby the Brooklyn Elevated Railroad Company will consent to pay the Brooklyn Bridge 10 cents per car upon a minimum number of 2500 cars per day crossing the bridge, provided the cable system is stopped. In this event, Mr. Shea, the Commissioner of Bridges, has asked that the elevated railroad company pay the additional expenses of motive power, operation and $20,306 per annum rental for terminals.

THE STATE BOARD of Railroad Commissioners at Albany on June 7 granted two of the applications recently filed by the Metropolitan Street Railway Company of New York City for authority to use the underground conduit system on lines operated by it. The two applications cover Columbus Avenue, between 106th and 110th Streets, and between Fifty-ninth and Sixty-fifth Streets. These portions of the company's lines are used as connecting links by other lines operated on the underground conduit system, and the commissioners decided to grant the applications at once on the ground that it would be in furtherance of the public interests to do so.

WHAT STREET RAILWAYS PAY THE CITY.—In a report presented by Comptroller Coler to the Rapid Transit Commission, a few days ago, some interesting figures are given, showing the amounts paid to the city by the street railway companies operating in Manhattan Borough. According to his figures the Metropolitan paid $223,526.76 for franchise percentages, $42,550 for car license fees, $66,242.40 for real estate tax, and $317,659.17 for personal property tax, making at total of $649,978.33. The total number of passengers carried (exclusive of transfers) from June 30, 1896, to June 30, 1897, was 77,776,093, and the gross earnings were $8,888,804.66, making the tax and franchise cost .0731 per cent. of the gross earnings and the average cost a passenger for all charges nearly one-third of a cent. The Third Avenue road, Mr. Coler said, has paid nothing for car license fees and franchise percentages since January 1, 1894. The total amount of taxes paid by it for real and personal property in 1897 was $72,687.98. The gross earnings for the year ending June 30, 1897, were $2,590,473.94. The number of passengers carried, exclusive of transfers, 51,809,480, making the average cost of a passenger in taxes nearly one-seventh of a cent.

New England Notes.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Build'ng, 620 Atlantic Ave.,
BOSTON, Mass., June 11 1898.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, has recently received an order from one of the largest railway signal manufacturers for over 3000 cells of its No. 2 Samson Battery. The order was placed after exhaustive tests of this and other makes of open-circuit batteries.

MR. W. O. TURNER has resigned his position with the Anchor Electric Company, Boston, and will hereafter be located in New York City, succeeding Mr. A. T. Bell as New York agent of the well-known Boston electrical establishment of C. S. Knowles. As traveling representative of the Anchor Company, Mr. Turner made a large circle of friends in Boston and New England, who regret his departure, and wish him in his new field of labor the success he justly deserves.

THE MAINE ELECTRIC COMPANY, Portland, Me., J. B. Phillips, manager, has just been awarded the contract for a 1500-light dynamo, to be installed in the West End Hotel, that city, and also a 75-kw multipolar generator, to be installed in the Maine General Hospital, both machines to be direct connected to an Ames engine. The electrical apparatus of the Maine Electric Company is of excellent manufacture and is giving good satisfaction wherever used. The company contemplates at an early date the extension of its manufacturing facilities and broadening out into the agency field, its Boston office, under the capable charge of Mr. Louis E. Hill, having proved successful beyond expectations.

Southern Notes.

WASHINGTON, D. C., June 10, 1898.

AT PUNTA ARENAS, Chili, in the Strait of Magellan, the first electric light plant in that part of the Republic is being installed and is rapidly nearing completion. The machinery and apparatus came from New York.

THE BUREAU OF AMERICAN REPUBLICS is advised that the municipality of Buenos Ayres, Argentine, has made a contract with the Compagnia General de Electricidad of that city to light the streets by electricity. The following prices are to be paid: 120 arc lamps burning all night, $27 each; 180 lamps burning till 1 A. M., $20.25 each. Each of the 300 lamps will take 8 amperes. These lamps will displace 990 gas lamps which now cost the city $7 each. The first contract is for one year only, until the city government shall authorize a new and more extended contract.

SOUTH AFRICAN INDUSTRIAL AND ART EXHIBITION.—United States Consul Stow writes to the State Department from Cape Town, South Africa, that an invitation has been extended to American manufacturers and producers to exhibit their products at the exhibition which is to be held at Grahamstown in Cape Colony late this year. The exhibition opens on December 15, 1898, and closes January 21, 1899. It is to cover both industry and art and every effort is being made to make it a success. Among the promoters are the governors of Cape Colony, the South African Republic, the Orange Free State and Natal, and the high commissioners of Rhodesia and Basutoland. Exhibits from all parts of the world are solicited. There will be five classifications of exhibits, namely: (a) raw materials; (b) manufactures; (c) mining and machinery; (d) natural history and science; (e) arts. The exhibition will be called the South African Industrial and Art Exhibition. Consul Stow says that the exhibition will be of incalculable benefit to manufacturers of electrical apparatus, machinery of all kinds, vehicles, agricultural implements, etc., etc. The American goods are becoming widely and favorably known in South Africa, and this exhibition will present an opportunity of still further popularizing American products.

REVISING AND CLASSIFICATION OF PATENTS.—On June 6 the House of Representatives passed a bill providing for the revising and classification of letters patent. By the provisions of the bill the Patent Office will have an increased clerical force, by whose assistance it will be possible to relieve the present congested condition of affairs. An even more important provision is that which gives the bill its title, namely, the revising and classification of letters patent. For the purpose of determining with more readiness and accuracy the novelty of inventions for which applications for letters patent are or may be filed in the Patent Office, and to prevent the issuance of letters patent for inventions which are not new, the Commissioner of Patents is authorized to undertake the revision and perfecting of classification. The business of the Patent Office in the last ten years has increased 33 per cent., while the force for conducting the business has been increased but 6 per cent. Commissioner Deuel is much pleased over the passage of the bill. Under the present state of affairs many inventors are unable to have their inventions passed upon because the Government is so far behind in the work of investigation, and it frequently happens that in the case of many novelties the season for them passes before the inventor can secure a patent.

Buffalo and Niagara Falls Notes.

BUFFALO, N. Y., June 11, 1898.

THE CURTIS ESTATE has given out plans and specifications for an electrical equiptment for the new malt house it is building at Black Rock. It will require from 100 to 200 horse-power.

THE CITY has been asked to permit the extension of the Niagara power line up Genesee Street to the Urban flour mill. A somewhat smaller cable than that used on the main line is to be put in.

PERMISSION has been granted the Conduit Company to lay the Niagara cable in Niagara Street to the city line, and work will begin at once. Vitrified clay conduits made by the H. B. Camp Company, Aultman, Ohio, will be used.

THE POSSESSION of the Niagara River front for trolley purposes is now said to have been obtained by George P. Smith, who owns the Tonawanda city line, and the oldest line from Buffalo to Tonawanda. This covers the approach to the proposed Grand Island bridge. Mr. Smith has already laid considerable new track, and the road will be running to the Bedell House ferry this summer.

THE CATARACT POWER & CONDUIT COMPANY, which has the handling of the Niagara Power Company's business in Buffalo, has applied for a permit to lay the main cable underground through Black Rock. At present it is on poles along the line of the canal up as far as Brace Street at Upper Black Rock, but the officials of the company have always felt uneasy about it, especially as it traverses a district that is quite generally occupied by small wooden buildings, and a fire in one of them would be more or less certain to injure the cables. Local residents are likely to oppose the permit on account of the new asphalt pavement that will have to be torn up.

IMPORTANT BUSINESS MEETINGS of the Niagara Falls Power Company were held here and at Niagara last week. President Adams, of the Construction Company, President Sellers, of the Power Company, Secretary Rankine of both companies, and Directors Francis Lynde Stetson and Edward A. Wickes, of the Power Company, came up from New York, re-elected the board and held a meeting with the local managers, Messrs. Urban and Huntley, of the Conduit Company, of which they are also members. The annual meeting of the Construction Company, which operates under a New Jersey charter, was held in that State last week. All the directors were re-elected.

THE EVENT OF THE WEEK is the collapse of the Buffalo Traction Company, which was gobbled up in good style by the older company, and Buffalo is again with a single street railway system. This arrangement was without doubt the intention from the start, the new company being organized as an apparent competitor of the old, and was thus enabled to obtain certain franchises and other privileges that were denied to the original company. The change was effected by the controllers of the old company obtaining a majority of the stock of the Traction Company. As an independent venture the new road was a failure financially, as its running expenses far exceeded its earnings. As a part of the old system it will be a help, as it is one of the best built plants in the country.

Pittsburg Notes.

Pittsburg, Pa., June 10, 1898.

ANOTHER TROLLEY ROAD IN THE MONONGAHELA VALLEY.—The announcement is made that the Homestead & Highlands Street Railway Company and the Homestead & Duquesne Company, will be consolidated, and will be operated under the name of the Monongahela Street Railway Company. The contract has been let for the construction of a boulevard, upon which the tracks will be laid between Homestead and Duquesne. The route of the Homestead & Highlands road will be changed, and new tracks will be laid on Forbes Street, connecting with those of the Consolidated Traction Company. New car barns will be built, the power house will be rebuilt and enlarged, and a number of new cars will be purchased. When completed the system will afford an entirely new line between the city and McKeesport, with Braddock as an intermediate point.

HOME TELEPHONE COMPANY ASKS FOR MORE TIME.—The Home Telephone Company has petitioned councils for an extension of time on its franchises, and an ordinance granting the request has been introduced. The existing ordinance requires that 1000 telephones be in operation by May, 1898, and 1000 more in each of the two succeeding years. The new ordinance, which was referred to the Corporations' Committee, gives the company another year in which to place the first 1000 telephones. Mr. H. Samson, the president of the company, states that it has a bona fide intention to build its telephone system and give the people of Pittsburg a better and a cheaper telephone service. It is alleged that a reorganization of the Home Company, consisting wholly of Pittsburg business men, has been effected, that ample capital is available and that active work upon the construction of its system will be resumed at once. It is further stated that $500,000 in cash will be available at once for the prompt prosecution of the work.

Chicago Notes.

Branch Office of THE ELECTRICAL WORLD,
938 Monadnock Building,
Chicago, Ill., June 10, 1898.

A CONSOLIDATION has just been effected between the Cutler-Hammer Manufacturing Company, Chicago, and the American Rheostat Company, Milwaukee. The business will be continued under the name of the Cutler-Hammer Manufacturing Company. The machinery of the American Rheostat Company is now being installed in the Chicago factory. Mr. H. H. Cutler, who was president of the Cutler-Hammer Manufacturing Company, will still retain an active interest in the new company, and will be able to devote more of his time to the engineering department, thereby insuring a high-class output.

MR. DICKINSON MacALLISTER, receiver of the West Side Metropolitan Railway Company, has been granted permission by Judge Showalter in the United States Circuit Court to expend $146,210 in building an addition to the present power house and increasing the available electrical power. If the present plans of the receiver are carried out the electric power will be nearly doubled. The receiver states that it is his intention to increase the capacity of the plant in order to compete with the surface lines that are now running close to all the branches of the Metropolitan road. The fact that the use of the Union loop has so increased traffic on the road that the present plant is inadequate to handle it properly is also given as another reason for the improvements. Bids will be advertised at once for the work, and it is expected that the work will be completed before cold weather sets in. According to the present plans of the receiver, it is intended to add engines and generators of 4000 horse-power, and in the near future to further increase the capacity of the plant 2000 horse-power to be used when the requirements of the road demand it.

Milwaukee Notes.

Milwaukee, Wis., June 10, 1898.

MR. L. S. FAINTER, of Menominee, has bought the interests of James E. Keelyn in the Eau Claire & Chippewa Falls Independent Telephone Company.

THE MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY will open the line to Waukesha some time this month. The line to Whitefish Bay will also be opened this month.

THE MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY has decided to build two lines to Whitefish Bay instead of one, as reported. One will run along the Milwaukee River, and the other the Lake Michigan shore. Some very fine scenery lies along these routes.

THE 4-CENT STREET CAR FARE case has been decided against the city. Judge Seaman, of the United States Court, rendered this decision on May 31. The case involved the validity of the ordinance to compel the street railway people to sell twenty-five tickets for $1. The street railway company attacked the ordinance on the ground that it was unreasonable and that the Common Council had no power to pass it. The city will probably appeal the case to the United States Supreme Court. The company, however, in view of its victory may concede a 4-cent fare.

THE CLOOS ELECTRICAL ENGINEERING COMPANY is a new enterprise in this city, with offices on the third floor of the Cawker Building. The officers are: President, Herman W. Falk; vice-president, consulting electrical engineer and general manager, Jacob Cloos; secretary, E. A. Wuerster; assistant secretary, Clarence H. Falk; treasurer, H. R. King. The company's motto is "No arc, no spark, no danger." It will handle a number of electrical specialties and will also take contracts for complete electric lighting plants, while long-distance power transmission will be made a specialty, the Cloos devices being used.

St. Louis Notes.

St. Louis, Mo., June 10, 1898.

TWO SUBURBAN EXTENSION bills have passed the Municipal Assembly and are now before the mayor. The bills grant rights to build important extensions.

CITY WIRES TO GO UNDERGROUND.—Improvements costing $52,000 are contemplated in the city system of fire alarm and police telegraph wires. An ordinance appropriating the required amount is soon to be introduced into the General Assembly. The main idea is to put all the fire alarm and telegraph wires under ground.

IT IS POSSIBLE that rates for electric current will be lowered a bit when the Imperial Electric Light, Heat & Power Company enters into competition with the Laclede and Edison companies. Contracts are already being made with consumers for periods of from three to four years. The company will soon be ready for business, and will compete for the city lighting.

RUMORS OF CONSOLIDATION.—It is reported that the "Day" and "Suburban" electric lines are to be consolidated. The rumors of a prospective consolidation are seemingly given force by the continuance of the pending injunction suits in the Belleville Circuit Court. Officials of neither road will admit that the rumors are well founded, but they do not deny them very strongly.

WIRES IN ALLEYS in the subway district must go underground the same as wires in the streets. This is the effect of an opinion rendered Friday last by the city counselor to the Committee on Water Works and City Lighting of the Board of Public Improvements. Wire users asked permission to string their wires on poles in alleys. This caused the request for the city counselor's opinion.

THE CARONDELET ELECTRIC & POWER COMPANY wants to know whether the mayor has the power to grant to street railway companies permits to do electric lighting business, which they are not authorized by their franchises to do. The protest is caused by the electric railways furnishing current for incandescent lights at gardens in which the various railroads are interested on the line of their roads.

THERE IS a general complaint that the water mains throughout the city are being corroded by the action of the return currents of the street railways whose tracks are in the neighborhood. It will cause great damage and great inconvenience to the city, through the shutting off of water for making necessary repairs. Complaints of late years have been numerous, as the regulations relating to street railways have not been revised since the horse-car period.

THE CENTRAL TRACTION COMPANY, at a meeting of the directors and stockholders, held Tuesday, decided to accept the franchise recently passed by the Municipal Assembly over the Mayor's veto. As soon as the acceptance is formally filed Attorney-General Crow will institute a new quo warranto suit to declare the franchise void, and the petition will include allegations based on the recent grand jury investigations of the charges of bribery in the Municipal Assembly. Tuesday's meeting will be followed by another, at which a proposition to increase the company's capital stock from $100,000 to $5,000,000 will be voted on.

STRIKE.—About sixty inside electrical workers went on a strike June 1, and as a result inside wiring, armature and fan motor work is almost at a standstill. The strike was inaugurated by the National Brotherhood Electrical Workers of America, Union No. 1, and is directed against the St. Louis Electrical Exchange. The journeymen signed an agreement to remain out until the bosses agree to pay them $3 a day instead of $2.50, the former schedule. Two firms have already signed a new agreement and their men have gone back to work. The point at issue is whether sufficient notice was given by the journeymen for an increase in wages.

Pacific Coast Notes.

San Francisco, Cal., May 29, 1898.

THE NORTHWEST TELEGRAPH & TELEPHONE COMPANY recently completed its telephone line from Huntington, Ore., to Gray's Landing, distance 8 miles. The line will be further extended to the Seven Devils.

THE SACRAMENTO, Cal., street lighting contract was recently awarded to the Sacramento Electric, Gas & Railway Company, at $6.15 a lamp per month. Two hundred and seventy arc lamps will be used on all-night schedule. Current is derived from a water-power transmission plant.

THE SACRAMENTO CHAIN-GANG recently did some very expensive work for the telephone lines by felling a tree across the 20,000-volt transmission lines of the Central California Electric Company and those of the Sunset Telephone Company. Three circuits were grounded and much damage caused.

CANADIAN NOTES.

OTTAWA, Ont., June 11, 1898.

MR. J. W. SCOTT, an enterprising citizen of Napanee, Ont., has closed a contract with the Canadian General Electric Company for a 100-kw, 4000-volt, three-phase generator of the revolving field type, for the purpose of supplying light and power to the town of Napanee, from a water-power 8 miles distant from the town. He will also supply light and power to intermediate points.

THE WEST KOOTENAY POWER & LIGHT COMPANY is rapidly completing its power plant at Bennington Falls. The poles are set and two wires are stretched between the Falls and Rossland, a distance of 31 miles. The line goes into Rossland over the Monte Cristo Mountain, and it is the intention of the company to stretch another wire, so that in case of accident there will be no interruption of the current. The first cost of the plant is placed at $125,000, but it is said that the expenditure upon it may be extended to $500,000.

AN AUTOMATIC ELECTRIC CAR FENDER has been invented by Mr. G. W. Rochester, of Ottawa. It consists of several pieces of wire netting, arranged on cross bars in such a manner in the front of electric cars that the moment any object strikes this netting, another net shoots out in front of the car directly along the ground, and picks up the object encountered. There is no possibility of anything getting between this fender and the roadway. The fender is attached to the car in such a way moreover as to take up little space, and when not in use may be folded under the car. Mr. Rochester states that his invention has been tested on an electric car in one of the sheds here, and that those electric railway officials present on the occasion pronounced the contrivance as wonderful.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, May 25, 1898.

INTERNATIONAL CHEMICAL CONGRESS.—The French committee of the electro-chemical section of the International Congress of Applied Chemistry, which will meet at Vienna, Austria, in July, is made up as follows: President, M. Moissan, a member of the institute; members, MM. Becker, Bullier, Gal, Gosselin, Luntz, Kordo, Minet, Peyrusson and Tommasi.

THE AMPERE INSTITUTE.—Thanks to the initiative of M. St. Julien, the town of St. Germain, near Paris, is soon to have a professional school of electricity. The Ampère Institute is intended to furnish laborers and foremen with an electrical education, and will give its pupils solid instruction in both theory and practice. We can but wish success and prosperity to this new establishment, which is destined to be of great service, both to the working class and to the electrical industries.

ANDREOLI OZONIZERS.—The celebrated French savant, E. Andreoli, has founded in London an electric ozone syndicate, which exploits a form of apparatus for the production of ozone, which has reached very satisfactory development. It is possible to put up ozonizers producing in the neighborhood of 100 grammes of ozone per horse-power hour. The apparatus is entirely made of aluminum, does not heat and will run continuously. The company constructs ozonizers giving from 100 grams to 1000 grams or more per hour.

THE MANUFACTURE OF CALCIUM CARBIDE IN THE PYRENEES.—M. La Prade, who has built an electric power plant at Arudy, is negotiating with La Compagnie Nouvelle d'Electricité for the use of 500 horse-power for calcium carbide furnaces, 100 to be otherwise used; 70 for the Wood Pulp Fibre Company and 30 for the lighting of the village. M. de Stampa, the engineer of La Compagnie Nouvelle d'Electricité, is pushing actively the work on the new plant, so that soon with the aid of three electric furnaces it will be able to produce 2 tons of carbide per day. This is a new industry which promises to render valuable the water falls of the Pyrenees and the Alps and to give work to the poor inhabitants of the mountains. But it will be necessary for the success of this industry to reduce the freight tariffs; the coastwise navigation is not well suited to the transportation of calcium carbide because of the danger arising from contact with water, and the railroad companies make quite high charges for its transportation from the Pyrenees to Paris, the transportation of 1, ton costing 120 francs, which should be compared with the charges on petroleum of about 50 francs per ton. There has been incorporated another company for the manufacture of calcium carbide called the Société Electrochimique Francaise. This company possesses a water fall in the upper Alps with an available power of 500 horse-power. This company will commence work next September.

UTILIZATION OF THE RHONE FOR POWER.—The work of develing a water power, which has been undertaken at Bellegarde (Ain) at the point where the Rhone disappears from view, has many interesting features. At this point, well known to tourists, the width of the river, which is shut in between two rocks, is reduced to 10 or 12 feet, and then the water falls with a terrific roar into a deep pit; at times of low water, especially in winter, the river disappears from sight for a distance of 650 feet, emerging again below the bridge which connects the department of Ain with that of Upper Savoy. The damming of the Rhone was an engineering feat involving considerable boldness and great rapidity of construction. The work was begun on January 13 last, by putting in place above the pit heavy I beams of steel, which formed the support of a masonry arch built with Portland cement. On this arch was built a double vault of rubble work on which rests the body of the dam, the whole forming a solid pier. This piece, containing about 10,000 cubic feet of material, was finished by the 27th of the same month. The masonry pier was pierced with vertical holes for the reception of enormous I beams, which extended to the bed of the Rhone. These beams were inclined down stream slightly and were intended to act as a mud sill at the bottom. Directly after lowering the beams into place four enormous cases filled with cement, and weighing 37 tons each, were lowered down a little up stream. These cases, on bringing up against the grating, formed the base of the dam, and at once held back some of the water emptying into the pit; next, large timbers were put in place against the upper part of the grating, just above the cases. After this, rock was quarried from the banks of the stream by means of sulphuric acid, and more than 20,000 cubic feet of rock, tree trunks, etc., were piled up against the dam. On February 15, one month after the inception of the enterprise, the result sought for was attained, and the imprisoning of the waters of the Rhone in the reservoirs of the Water Power Company of Bellegarde was an accomplished fact. This work, which provides a large increase in the available water power, renders possible the erection of a new station. Thanks to this bold enterprise, the available energy will finally be more than trebled.

General News.

NEW INCORPORATIONS.

THE FAYETTE COUNTY ELECTRIC RAILWAY COMPANY, Fayetteville, W. Va., has been formed, with a capital of $30,000.

THE HAMLIN-HUNTINGTON TELEPHONE COMPANY, Hamlin, W. Va., has been formed, with a capital stock of $10,000.

THE INTERSTATE TRACTION COMPANY has been incorporated at Duluth, Minn., with a capital stock of $50,000.

THE BOWLING GREEN STREET RAILWAY COMPANY, Bowling Green, Ky., has been incorporated, with a capital stock of $40,000.

THE KNOXVILLE ELECTRIC COMPANY has been incorporated at Knoxville, Tenn., by J. E. Willard, F. E. McBath, A. McMillan, A. M. Francis and F. E. Bordman.

THE SHEFFIELD ELECTRIC LIGHT COMPANY, Sheffield, Ill., has been formed, with a capital stock of $9000. The incorporators are: T. Sprague, D. J. Dewey and W. L. Jones.

THE BUSHNELL TELEPHONE COMPANY, Chicago, Ill., has been organized with a capital stock of $5000. The incorporators are Joel Lighter, E. E. Johnson and H. A. Cleveland.

THE LODI LIGHT, HEAT & POWER COMPANY, Lodi, N. J., has been organized, with a capital stock of $100,000. The incorporators are: Frank T. Ternes, Philip S. Hoffman and C. I. Ternes.

THE MISSOURI & IOWA TELEPHONE COMPANY, Princeton, Mo., has been incorporated, with a capital stock of $25,000. The incorporators are: J. S. Rogers, H. G. Orton, E. M. Hyde, and others.

THE VICKSBURG ELECTRIC LIGHT & POWER COMPANY, Vicksburg, Ill., has been formed, with a capital stock of $100,000. Among those interested are Percival Steele, David R. Lamonte and C. D. Donavan.

THE A. L. SWETT ELECTRIC LIGHT & POWER COMPANY, Medina, N. Y., has been incorporated, with a capital stock of $50,000. The incorporators are: A. L. Swett, A. J. Howard and F. Marion Poler, Medina, N. Y.

THE HOWARD ELECTRIC COMPANY, Chicago, Ill., has been incorporated, with a capital stock of $25,000, to manufacture electrical appliances, etc. The incorporators are: Robert Greer, William Greer and James H. Parker.

THE MARANACOOK ELECTRIC LIGHT & POWER COMPANY has been organized at Augusta, Me. The officers are: President, Frank Ridlon, Dorchester, Mass.; treasurer, John A. Hamblin, Augusta. The capital stock is $10,000.

THE BADGER STATE LONG-DISTANCE TELEPHONE COMPANY, Baraboo, Wis., has been incorporated, with a capital stock of $100,000. The incorporators are: F. T. Brewster, F. A. Philbrick and W. H. Hatch, all Baraboo capitalists.

THE FERGUS TELEPHONE COMPANY has been incorporated at St. Paul, Minn., with a capital stock of $15,000. Among those interested are F. G. Barrows, Robert Hannah, E. A. Jewett, W. L. Parsons, all of Fergus Falls, and W. H. Davy, of Moorhead.

THE CENTRAL TELEPHONE COMPANY, Des Moines, Ia., has been formed by H. E. Teachout, J. W. Hill, M. McFarlin and H. C. Hansen, with a capital stock of $10,000. This company has been organized to build toll lines in conjunction with the Mutual Company.

THE SUFFOLK GAS & ELECTRIC LIGHT COMPANY has filed articles of incorporation at Albany, N. Y., for the purpose of operating in the towns of Islip and Babylon. The directors are: Hunter Wykes, Charles F. Street, William B. Hood, of New York City. Capital, $200,000.

THE EASTON TELEPHONE COMPANY has been incorporated at Easton, Pa., to maintain and construct lines in Lehigh and Northampton Counties. The directors are: E. L. Reinhold, Marietta; William Coyle and George F. Coffin, Easton. The capital stock of the new company is $1000.

THE MARTIN TELEPHONE COMPANY, Johnson City, Tex., has filed articles of incorporation, with a capital stock of $10,000. The purpose of the company is to construct and maintain a telephone line in Blanco, Hays, Travis, Burnet, Llano, Gillespie and adjoining counties. The incorporators are David Martin, J. W. Shugart and A. G. Peery.

THE ASBURY PARK & SEA GIRT RAILROAD COMPANY, Asbury Park, N. J., has been formed with a capital stock of $100,000. The incorporators are: John E. Comins, Arlington; D. H. Shea, and H. B. Perrine, New York. The company is empowered to acquire the franchise and effects of the Asbury Park & Belmar road, to be sold under direction of the court.

The Telegraph and Telephone.

SAULT STE. MARIE, MICH.—The Michigan Telephone Company is constructing a metallic line to Bay Mills.

PORTSMOUTH, N. H.—A telephone connection is to be made with the fortifications at New Castle and Jerry's Point.

MILFORD, IND.—A new telephone line will, in the near future, be built from this place to Syracuse and Lake Wawasee.

ANN ARBOR, MICH.—The New State Telephone Company has begun work upon its extension to Whitmore, Portage and Zukey Lakes.

OTTAWA, ONT.—The Dominion Government is about to re-lay the Pelee Island telephone cable. This island lies near the western end of Lake Erie.

STATESVILLE, N. C.—A telephone line from Bakersville to Cranberry via Linville is now in operation, and a line is being built from Bakersfield to Marion.

NILES, MICH.—The Gilliland Telephone Company has announced its suspension in this place. It is stated that this action was due to the fight with the Bell Company.

NEWPORT, PA.—The Town Council has granted the right of way through the streets of Newport to the Tuscarora Valley Telephone Company and the Pennsylvania Telephone Company.

FREDERICKSBURG, VA.—The Orange Telephone Company is building a branch line from Unionville to Lahore, from which point it will be extended to Thorn Hill, a distance of 12 miles from the main line.

BOSTON, MASS.—The Bell Telephone Company's instrument report for the month ended May 20 shows the following results: Gross output, 32,441, returned, 11,948, and net output, 20,493; total number of instruments outstanding, 997,838.

SOUTH BEND, IND.—The Citizens Telephone Company has bought the old Bankers and Merchants telegraph line from this city to Laporte, a distance of 30 miles. This stretch of line will enable the Citizens Company to establish connections with various places in this section. Copper wire will be strung.

Electric Light and Power.

PHILADELPHIA, PA.—The Borough Council of Sea Isle City has advertised for proposals for supplying that resort with electric lights.

CASS CITY, MICH.—At the special election it was voted to issue $18,000 in bonds for the purpose of putting in a water and light plant.

GAYLORD, MINN.—The city of Gaylord, at an election on June 7, voted to put in an electric light plant. Bids will be received by the town.

McARTHUR, OHIO.—An ordinance has been passed authorizing the issue of $5000 in bonds for the erection of an electric light plant. G. W. Pearce is clerk.

UTICA, N. Y.—A syndicate is forming to erect an electric light plant on the site of the old Anderson tannery at Hawkinsville, to furnish light for Boonville.

BANGOR, ME.—The Ellsworth Electric Illuminating Company's plant is now equipped to run by water-power or steam. In the event of any accident to either the other can be immediately substituted.

OMAHA, NEB.—The Lagoon and Grand Court on the grounds of the Trans-Mississippi & International Exposition will be lighted entirely by incandescent electric lamps, a feature, which, it is stated, has never been before attempted at a similar enterprise. There will be 8,156 lights with a combined candle power of 163,120.

NATCHEZ, MISS.—A ten-year contract for lighting the streets of this city has been awarded to Messrs. A. & M. Moses. The contract calls for 100 arc lights at $103 per light per annum; incandescent lights to the city, 15 cents per 1000 watts, meter measurement; arc lights to private citizens and corporations, 18 cents per 1000 watts.

NEW YORK CITY.—Application was made to Justice Johnson, in Brooklyn, for an injunction restraining the Amsterdam Electric Illuminating & Power Company from disposing of the plant and franchise of the State Electric Light Company, of which it has control. Mark Farrell, a stockholder of the State Company, is the petitioner. He alleges fraud and mismanagement.

BOSTON, MASS.—The House, on June 2, by a vote of 119 to 90, passed the Street Railway bill. It provides that all dividends over 8 per cent. on capital stock shall be paid to the State, that a graded excise tax shall be levied by each town or city through which the street railway passes, and that the amounts raised by both these methods of taxation shall be applied toward the construction, repair, and maintenance of public ways, and the removal of snow therefrom. The Boston Elevated Railroad Company and all its leased lines are exempt from the provisions of the act.

The Electric Railway.

NEW YORK CITY.—The Peekskill Traction Company has accepted the franchise recently granted by the village.

SAUGATUCK, MICH.—This village has voted $2500 bonds to aid the construction of the Saugatuck, Douglas & Lake Shore Electric Railway.

CHICAGO, ILL.—The Union Transit Company, incorporated with a capital of $50,000 a year ago, will ask the council for a franchise covering 20 miles of streets.

SYRACUSE, N. Y.—The new Eastwood & East Syracuse Railroad Company has been transferred to the Rapid Transit Company for an annual rental of $10,000.

NEWARK, N. J.—Plans are out for a large power plant at Little Falls, N. J., on the site of the present pumping station. This building, when completed, will be one of the largest in the county.

JERSEY CITY, N J.—Mayor Hoos, of Jersey City, has vetoed the ordinance allowing the Grove Street Railway line to be operated on the trolley system, because the ordinance does not require the road to compensate the city.

CHICAGO, ILL.—The Laporte & Michigan City Electric Railroad Company, with a capital of $50,000, has just been incorporated at Anderson, Ind. Most of the contracts have already been let, and grading has been started.

NEWARK, N. J.—The Board of Public Works has given the South Orange Railway Company its franchise for 5 miles of tracks. The round-trip fare to New York will be 24 cents, a reduction of 33⅓ per cent. from the steam roads' fare.

POTTSVILLE, PA.—The Edison Electric Illuminating Company is rapidly getting control of the lighting plants near Pottsville. The company's latest acquisition is the Port Carbon plant. The Edison Company can furnish power and light within a radius of 100 miles of Pottsville.

HINGHAM, MASS.—The directors of the Plymouth & Sandwich Street Railway Company have decided that a survey for the construction of the line be made at once. Chas. W. Howland, of Rockland, a civil engineer, is to make the survey and have charge of the construction.

NEW YORK CITY.—The Elizabeth (N. J.) & Westfield Street Railway Company has secured a franchise from the Fanwood Township Committee to build a trolley road through Scotch Plains to connect with the proposed extension of the Plainfield Street Company's line. The company has been endeavoring to get this for a year.

NEWBURYPORT, MASS.—The Boston & Maine Railroad has surveyed the line for an electric railway from Portsmouth through Rye and Little Boar's Head, to the causeway in Hampton. The Exeter Street Railway has a right under its character to build to the North Hampton line and may build through North Hampton.

SPRINGFIELD, MASS.—The mayor recently notified the street railway company that the time limit for the removal of the double tracks from Walnut Street had almost expired, and has received a note from the company that the work will be begun this week. The unfavorable weather is the excuse for not beginning before.

OGDENSBURG, N. Y.—An electric street railroad in Malone seems practically assured. The village Board of Trustees has voted to grant the charter, and the company will be incorporated with a capital of $30,000. The name of the corporation will be the Malone Electric Street Railway Company. The names of the directors are not made public. Four of them will be residents of Malone.

Legal Note.

THE REVERSIBLE TROLLEY PATENT.—The Walker Company writes to The Electrical World that Judge Shipman has just decided the foundation reversible trolley patent in its favor. The bill brought against the Walker Company by the General Electric Company was dismissed with costs.

Personal Notes.

PROF. J. J. FLATHER, of Lafayette, Ind., has just been appointed Professor of Mechanical Engineering in the University of Minnesota, Minneapolis, Minn. Professor Flather was appointed Professor of Mechanical Engineering in Purdue University seven years ago, and during that time aided very materially in building up the work in mechanical engineering at that institution, especially along the lines of steam engineering and machine design.

MR. FRANK J. SPRAGUE, who has been confined to his house for the last six weeks suffering from an injury to his right eye, is now in a fair way to recovery. Nearly two months ago a piece of his eye glass was broken off and forced into the ball of the eye, and Mr. Sprague was under the care of a specialist for about two weeks. He afterward caught cold in the injured eye. Severe complications set in, and for some time it was feared that blindness would be inevitable. This danger, however, seems to have passed, and there is now every prospect that Mr. Sprague will soon be able to resume his active duties with his company and in the formation of a volunteer corps of electrical engineers for war service.

Trade and Miscellaneous Publications.

MESSRS. HARRISON BROTHERS & CO., Philadelphia, Pa., manufacturers of white lead, colors, paints, varnishes and chemicals, have just issued a new edition of their descriptive catalogue and price list. It contains ninety-six pages, and is fully illustrated.

"POWER, PROFIT AND PROSPERITY" is the comprehensive title of a little pamphlet published by Mr. William Webber, 53 State Street, Boston, Mass. Mr. Webber is a designing and contracting engineer, and in this pamphlet suggests many ways in which economies can be practiced in power plants.

MESSRS. ZIMDARS & HUNT, 127 Fifth Avenue, New York, have issued two little folders illustrating and describing a few of the high-grade electric light and power specialties shown at the Electrical Exhibition at Madison Square Garden, New York. The illustrations show knife switches of different kinds, voltmeter switch and panel boards.

MESSRS. STONE & WEBSTER, electrical experts and engineers, 4 Post-office Square, Boston, Mass., have issued a booklet giving some statistical matter regarding the street railway and electric lighting properties in Massachusetts that will be of general interest. A list of properties examined and reported upon by the firm is also included in the work.

THE WESTERN ELECTRIC COMPANY, Chicago, has issued Bulletin 4 F, descriptive of alternating-current ceiling and desk fan motors. The Tuerk ceiling fan motor is of the induction type. The armature rotates at high speed and the fan blades rotate at comparatively moderate speed, an ingenious means

of obtaining this reduction being provided. The desk fan motors are made for either 60 cycles or 125 cycles.

THE BULLETIN of the engineering department, University of Vermont and State Agricultural College, Burlington, Vt., gives a comprehensive description of each branch of the engineering science included in this department. The electrical engineering department possesses laboratories for experiments with direct currents, alternating currents and in advanced physics. The bulletin is well illustrated.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., in Bulletin No. 17, just issued, describes and illustrates its direct electrically driven ventilating fans. The motors are of the standard Wagner type for either 110, 250 or 500 volts direct current, and with self-oiling, self-aligning bearings, as well as all other special features of construction of these motors as built for power purposes. The illustrations show the standard form of ventilating fan arranged for flange support, for shelf support and ceiling support.

THE AMERICAN STOKER COMPANY, Broadway and Liberty Street, New York City, in a pamphlet just issued, describes and illustrates the construction of the American stoker, and shows, besides, its applications to boilers of various types. Reports of various tests showing the advantages to be derived by the use of this stoker are given. The pamphlet is very completely illustrated with views of many plants in which the American stoker has been installed.

Trade and Industrial Notes.

THE ATTICA ELECTRIC LIGHT COMPANY, Attica, Ind., is increasing its plant by the addition of a 125-hp Ball engine built by the Ball Engine Company, Erie, Pa.

THE PRISMATIC ELECTRIC SIGN COMPANY, Williamsport, Pa., has established a New York agency at 120 Liberty Street, Messrs. Amthor & Sterling being the representatives.

THE LAKON COMPANY, Elkhart, Ind., is shipping a 60,000-volt transformer to London, England, where it will be used for making all classes of laboratory and breakdown tests. The company reports that its export trade is rapidly growing.

THE ELECTRIC LIGHTING COURSE of the United Correspondence Schools, 154-158 Fifth Avenue, New York, it is stated, has done much to increase the technical knowledge of men who have enrolled. Six other electrical courses are taught at this institution. A special reduction is offered to those enrolling during the month of June. Circulars and information will be furnished on application.

A BALL ENGINE of 120 horse-power, built by the Ball Engine Company, Erie, Pa., will furnish the power for the electric lighting and power plant now being installed by Charles S. Weisse & Co., Sheboygan Falls, Wis., in their new works at that place. An electric light and power plant is being istalled in the works of the Jackson Corset Company, Jackson, Mich., the power for which will be furnished by a 60-hp Ball engine.

MR. E. A. GROETZINGER, general manager of the Charles Munson Belting Company, Chicago, is distributing to the trade a unique wall map of Cuba. It not only gives complete details of the manœuvres of the United States flying squadron, but at the same time forcibly calls attention to the fact that this enterprising and thoroughly up-to-date general manager is pushing his company's "Eagle" and "Dynamo" brands of leather belting to the limit.

SIX 500 HP. FEED WATER HEATERS is the first installment of an order now being filled by the Goubert Manufacturing Company, of this city. They are to be placed between the low-pressure cylinder and the condensers as primary heaters in the new Ninety-sixth Street station of the Metropolitan Street Railway Company, in New York. There will eventually be eleven of them, and the order is said to be the largest ever placed for feed water heaters.

GAS ENGINES.—In the issue of THE ELECTRICAL WORLD of March 12, 1898, was published a description of a gas and gasoline engine made by the Mianus Electric Company, Mianus, Conn., which is adapted to the driving of dynamos for electric lighting. The Mianus Company has applied this engine to the propulsion of launches, and has recently placed on the market a pleasure boat so driven. These boats carry from five to eight persons comfortably, and no licensed engineer or pilot is needed to navigate the same.

A GOOD EXAMPLE of the use of alternating current for short-distance transmission, ease of starting the motors from a distance, reversing the same, etc., is to be found in apparatus now being supplied for the Fitchburg (Mass.) grain elevators by the Westinghouse Electric & Manufacturing Company. This consists of one 125-kw two-phase generator, seven 20-hp and two 30-hp Westinghouse Type C motors, to be used in operating carriers in elevators. The induction motor is epecially adapted for work in dusty locations, such as the above.

MR. GEORGE M. MAYER, 79 Fifth Avenue, Chicago, Ill., reports a steady increase in his output and sales of telephone switchboards, telephones, telephone supplies and parts. The factory has been greatly enlarged to meet the growing business, and by the introduction of new and varied machinery and tools this concern is prepared to do, in connection with its regular business, a large amount of model making for inventors and experimenters. A very neat little catalogue will be mailed to anyone interested in this class of supplies by addressing the factory.

THE AMERICAN SILK MANUFACTURING COMPANY, Philadelphia, Pa., is meeting with great success with its engine and dynamo wiper, which is made out of pure raw silk, to take the place of the ordinary cotton waste generally used for this purpose. Among the many advantages claimed for this silk wiper is that it does not scratch the most delicate surfaces, may be easily washed, and wears a long time. It is claimed by the central station managers who use it continually that there is a saving of two-thirds in their waste bill in a year's run.

THE A. A. GRIFFING IRON COMPANY, Jersey City, N. J., reports that during the month of May it has done a very good business in the sales of Bundy steam specialties, which goes to show that there is always a constantly increasing market for a good article at a reasonable price when properly kept before the buying public. This apparatus has evidently become very well known, as a list of last month's sales furnished us shows that not only have electric lighting and power stations been furnished, but factories and mills in nearly all the States have ordered from this company.

THE CENTRAL ELECTRIC COMPANY, Chicago, reports a brick trade in the Westinghouse alternating current fan motors. One reason for this is undoubtedly the fact that it is carrying large quantities in Chicago stock, and hot orders in hot weather can be filled immediately. The company also reports a number of new specialties in its house goods department, prominent among them being a new device for electrically lighting the incandescent gas or Welsbach burner. It is marvellously simple, and will doubtless be appreciated by the trade who have been asking for a device of this character.

IN MAKING soldered connections on telephone switchboards and elsewhere in telephone work when it becomes necessary to solder wires of small diameter it is very essential to have a high-grade soldering flux. A soldering flux which will not injure the wire in any way, and at the same time will make a quick and sure joint, is very much desired. The Electric Appliance Company, Chicago, claims that it has something which fills all of these requirements in its Highland soldering paste, which is now being used very largely for telephone work and for fine instrument work generally. It is giving customers an opportunity to test this paste by sending free of expense small sample boxes.

THE WESTINGHOUSE INDUCTION MOTORS (type "C") are everywhere demonstrating their usefulness in new fields. Some two years since the Westinghouse Company installed for the Silver Spring Bleaching & Dyeing Company, Providence, R. I., a complete plant for power purposes, and the growth of the business since that time has recently called for an equipment of fifteen Type "C" induction motors of the latest type. The conditions of service are very severe indeed, many of the motors operating continuously in clouds of steam or in the presence of chloride fumes which rapidly corrode all exposed copper parts. Some of these motors have to exert four times the normal torque in starting ironing machines or calenders full of heavy gearing, etc. The installation, which was regarded as a risky experiment among such manufacturers when first contemplated, has, it is stated, proven a most pronounced success.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

THE PIONEER LIMITED is the name of the only perfect train in the world, now running every night between Chicago, St. Paul and Minneapolis via the Chicago, Milwaukee & St. Paul Railway—the pioneer road of the West in adopting all improved facilities for the safety and enjoyment of passengers. An illustrated pamphlet, showing views of beautiful scenery along the route of the Pioneer Limited, will be sent free to any person upon receipt of 2-cent postage stamp. Address Geo. H. Heafford, General Passenger Agent, Chicago, Ill.

UNITED STATES PATENTS ISSUED JUNE 7, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

605,067. ELECTRIC SWITCH; C. C. Badeau, Schenectady, N. Y. App. filed Sept. 17, 1897. In an electric switch, the combination of a switchboard, a stationary switch, members secured to said board, a pivoted switch blade co-operating with said switch members, and made from a strip of metal bent lengthwise upon itself, and of substantially uniform width throughout, and a handle secured to the switch blade at the bend.

605,097. TELEPHONE SYSTEM; E. W. Ham, Worcester, Mass. App. filed April 22, 1897. This invention relates to a system of intercommunicating or connected telephones; the object being to provide a simple, efficient and novel form of switchboard for use in connection with each of the telephone instruments and to combine said switchboard with a releasing mechanism for cutting out the connections when the telephone instrument is not being used.

605,109. INSULATOR; F. M. Locke, Victor, N. Y. App. filed April 23, 1898. This invention relates to improvements in insulators, having more particular reference to those which are made from porcelain or suitable insulating material.

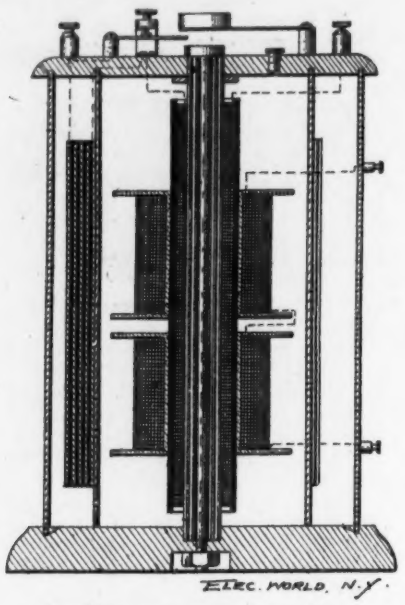
605,115. RAIL BOND; G. Moffat, New York, N. Y. App. filed Feb. 24, 1898. A rail bond, comprising two telescopically connected members, the said members adapted for engagement with openings in adjacent rail sections.

605,129. HEAT OR COLD INDICATOR; E. B. Petersen, Kearney, N. J. App. filed Aug. 11, 1897. In a heat or cold indicator, the combination, with an indicating mechanism, of a base plate, a longitudinal channel or chamber

therein, a metallic strip in said channel or chamber, secured at one end to said base, and a pivoted lever on said base, with which the other end of said strip is connected, and said lever being adapted to actuate said indicating mechanism.

605,154. INSTRUMENT-WINDING DEVICE; H. H. Wait, Chicago, Ill. App. filed Dec. 14, 1896. In an instrument-winding device, a chuck formed in two parts or sections, which are adapted to engage a core, each of said parts being provided with a lip, said lips being oppositely placed, the opposing surfaces of the lips diverging outwardly from the core-receiving surfaces of the chuck.

605,174. INDUCTION COIL; A. L. Bogart, Jamaica, N. Y. App. filed April 22, 1897. In a Ruhmkorff induction coil, the combination with the primary and secondary coils, of a condenser arranged in the same plane therewith and partially inclosing the same.



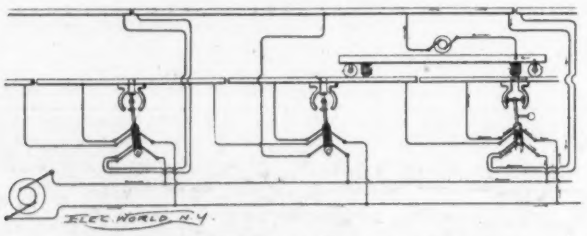
No. 605 174.—Induction Coil.

605,194. ELECTRIC TRANSFORMER; J. J. Bellman and C. T. Rittenhouse, New York, N. Y. App. filed June 29, 1897. The combination in a transformer, of a ferromagnetic field built up of integral plates so mortised that when the plates are properly assembled the core of the magnetic field will be approximately circular in cross-section.

605,197. ELECTRICAL VALVE-CONTROLLING DEVICE; A. E. Colgate, New York, N. Y. App. filed May 28, 1896. The combination with a valve, of a magnet for controlling the same, a circuit extending thereto, an automatic circuit controller for periodically opening and closing said circuit, and a single hand-operated switch for controlling the operation of the valve at will, and also for controlling the connection of the automatic controller with the valve-magnetic circuit.

605,211. TROLLEY SWITCH; J. H. Vanasselt, Seattle, Wash. App. filed Oct. 2, 1897. This invention relates to trolley switches or switches for guiding a trolley wheel from a main-line conductor to a turnout or siding conductor.

605,228. ELECTRIC-ARC LAMP; W. Hochhausen, Brooklyn, N. Y. App. filed Jan. 22, 1897. In an arc lamp, the casing containing the operating mechanism in combination with a vertical partition dividing the space inclosed by said casing into two chambers, one of them containing the mechanism to which access must be had in trimming, and means for gaining



No 605,317.—Electric Railway System.

ready access to said chamber from the exterior without opening into the other chamber.

605,251. TROLLEY-WIRE HANGER; G. E. Johnson, Los Angeles, Cal. App. filed Aug. 19, 1896. This invention relates to improvements in that class of trolley-wire hangers in which the guy and trolley wires are clamped by the hanger instead of being soldered thereto.

605,256. INSULATOR; R. D. Mershon, Colorado Springs, Col. App. filed Feb. 14, 1898. An insulator for high-tension circuits, having a long, tubular petticoat adjacent to the supporting pin, and a short outer petticoat of much greater diameter, the edge of which is approximately the same striking distance from the cross arm and the supporting pin.

605,260. MOUNTING FOR THIRD RAILS; S. H. Short, Cleveland, Ohio. App. filed Nov. 5, 1897. In a mounting for third or contact rails, the combination with standards, a bar supported by but insulated from said standards, an insulating strip or board supported by said bars and arranged to extend lengthwise with respect to the third or contact rail, said rail being arranged to rest on said strip or board.

605,261. THIRD RAIL FOR ELECTRIC RAILWAYS; S. H. Short, Cleveland, Ohio. App. filed Nov. 5, 1897. In an electric railway, the combination with standards, a bar supported by but insulated from said standards, a third or contact rail supported upon said bar, said rail presenting a side surface for contact with the shoe or collector, and a strip or plate laid lengthwise upon said rail and extending over the top edges thereof.

605,279. SAFETY LOCK FOR INCANDESCENT LAMPS; E. Faller and H. Herbstritt, San Francisco, Cal. App. filed Sept. 17, 1897. This invention relates to a locking device which is designed to prevent the surreptitious removal and stealing of incandescent-light globes.

605,294. TELEPHONE HOLDER; J. T. Moore, Minneapolis, Minn. App. filed Aug. 24, 1897. The combination of a pivotally supported lever, having a balance weight on one end and a telephone-receiver clasp on the other end, with a telephone-switch-operating connection.

605,304. CONTROLLER; T. Von Zweigbergk, Cleveland, Ohio. App. filed Feb. 23, 1898. In a controller, the combination with the controller shaft of a collar tightly surrounding the shaft and a trough below the collar, and adapted to receive water passing from it and convey it beyond the controller.

605,309. ELECTRIC-SELECTOR SYSTEM; T. C. Drake, Malta, Ohio. App. filed Feb. 26, 1897. This invention relates to a new selector system of electric signalling apparatus intended more particularly for use in connection with telephonic transmission, fire alarm, district messenger, and any service requiring individual signalling properties without the intervention of a central office or centrally located operating or controlling devices.

605,317. ELECTRIC-RAILWAY SYSTEM; W. Lawrence, New York, N. Y. App. filed Dec. 1, 1897. This invention relates to surface-contact electric railways in which the circuit is normally interrupted at intervals along the track. This circuit is closed and opened at points under the car by means of a magnetic device carried on the car.

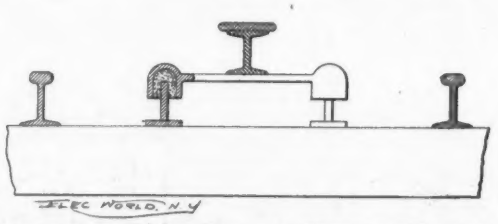
605,326. TROLLEY CONNECTION FOR ELECTRIC CARS; J. G. McLaughlin, Brooklyn, N. Y. App. filed Dec. 28, 1897. The combination of the trolley pole, a swinging frame having cheeks extending upward above and beyond the extremity of the trolley pole, and a wheel mounted between the upwardly projecting cheeks of the swing frame.

605,341. TELEPHONE SYSTEM; R. T. Reid and J. L. McDonnell, Tacoma, Wash. App. filed Sept. 25, 1897. This invention relates to an improvement in telephone systems, and more particularly to means for calling individual subscribers and permitting them to have the exclusive and undisturbed use of the line, one object of the invention being to provide simple and efficient means for calling an subscriber on a party line without sounding the signals of other subscribers.

605,345. CALL-BOX SYSTEM; E. E. Salisbury and A. E. Dean, Tacoma, Wash. App. filed June 22, 1897. This invention relates particularly to call-box systems in which the telephone forms an important part, and also to the method of operating an electric or magnetic speaking transmitter from a point to or from the central office over a permanently magnetized circuit without the use of a local battery to operate the same, and to a system of wiring the central office, which will also obviate the use of a local battery on the telephone.

605,358. SIGNALLING DEVICE; F. B. Taylor, E. E. Salisbury and A. E. Dean, Tacoma, Wash. App. filed July 23, 1897. The object of this invention is to enable an operator at a central office to automatically turn in any one of a number of outlying call boxes desired on a single circuit, and at the same time signal the subscriber without disturbing or signalling any other subscriber on the circuit.

605,359. RAILWAY SIGNALLING AND SWITCHING APPARATUS; J. D. Taylor, Chillicothe, Ohio. App. filed March 24, 1897. In a railway signalling and switching apparatus, a series of operating levers, primary and secondary locking bars, connections between the primary bars and levers, yielding connections between the primary and secondary bars, holding-latches for the secondary bars, and electrical means for releasing the latches.



No. 605,261.—Third Rail for Electric Railways.

605,361. FOG SIGNALLING APPARATUS FOR RAILWAYS; H. Tomlins, London, England. App. filed Nov. 22, 1897. In an explosive signalling apparatus, a revolving cartridge-holding disc, having pairs of cartridge-holding chambers or barrels arranged in a circle, the two members or barrels of each pair being on the same radius, in combination with a breech block common to the two chambers or barrels, and hinged to swing outward toward the circumference when opened, firing pins for the two barrels yoked together, and a firing hammer adapted to act on both firing pins.

605,424. CONNECTOR FOR STORAGE-BATTERY PLATES; G. Hart, Detroit, Mich. App. filed Jan. 13, 1898. This invention relates to secondary or storage batteries, wherein electrodes are arranged in cells or vessels, and connectors are employed for connecting the electrodes of one group of battery plates with the electrode of another group of battery plates.